Development of emotion lexicons to describe sugar-free chocolate according to consumers' taster status

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SUMMARY

Consumers' emotional response has been connected to their sensory experience of sugared products, determining food preference. However, limited research has been conducted on how consumers' different taster statuses influence their emotions when consuming sugar-free products, such as sugar-free chocolates. By showcasing the relationship between consumers' taster status and emotional response, emotional lexicons can be developed that can assist in product development, ensuring that the needs of all consumers are met. Furthermore, incorporating consumers' taster status will increase understanding of consumers' taste sensitivity and product preferences. There is a gap in the literature on consumers' PROP (6-n-propylthiouracil) sensitivity, as the assessment of taste sensitivity and sensory experiences related to products and sensory information has been avoided.

This study aimed to develop emotional lexicons for sugar-free chocolates based on consumers' taster status (non-, medium and supertasters) using the check-all-that-apply methodology. To reach this aim, five objectives guided this study: to determine consumers' taster status; to determine consumers' consumption, purchasing behaviour and acceptance of sugar-free chocolates; to determine emotional lexicons for sugar-free chocolate for consumers with different taster statuses; to determine the association between emotional lexicons and consumers' taster status; and to describe the demographic characteristics of consumers.

A quantitative non-experimental, descriptive and cross-sectional study was conducted using a self-administered electronic questionnaire to collect quantifiable data. South African adult consumers (N = 158) were included through a non-probability convenience sampling method with a set of inclusion and exclusion criteria. Descriptive analysis was performed for all variables, including means, frequencies and percentages. To assess if there is a significant association between consumers' taster status, demographic characteristics of consumers and the selection of emotional terms, cross-tabulations with phi coefficient and Cramer's V were performed.

According to the results, most of the respondents consumed chocolate once a week and the primary reason for consumption was for emotional satisfaction (indulgence). The respondents indicated that they mainly purchased chocolate for its flavour. Overall, they enjoyed the sugar-free chocolates and showed a higher liking for the dark chocolate compared to the milk chocolate. Therefore, sugar-free chocolate with sweeteners can be enjoyed and consumed as a healthier alternative. The emotional lexicons were similar, although there were a few differences. While mostly positive emotions were selected, the lexicons revealed that the supertasters felt more negative emotions compared to the medium tasters and non-tasters. There was a practical

significance of the association between non-tasters and the contented and guilty emotion for the milk chocolate as well as between supertasters and the discontented and disgusted emotion. These emotional lexicons will contribute to future research on the sensory acceptability of and behaviour with regard to chocolate and sugar-free products for the South African market.

KEYWORDS

- Check-all-that-apply (CATA) methodology
- Consumers' taster status
- Consumption frequency
- Emotion
- Emotional lexicon
- Purchasing behaviour
- Sensory evaluation
- Sugar-free chocolate

LIST OF ABBREVIATIONS

CATA	check-all-that-apply
EFA:	Exploratory factor analysis
HREC:	Health Research Ethics Committee
LMS:	Labelled Magnitude Scale
MT	medium tasters
NT	non-tasters
NCDs:	Non-communicable disease
NWU	North-West University
PROP	6-n-propylthiouracil
SCS:	Statistical Consultation Services
SPSS	Statistical Package for the Social Sciences
ST	supertasters
TAS2R	taste 2 receptor
WHO	World Health Organization

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CHAPTER 1 INTRODUCTION

1.1 Introduction

Sugar has become a significant hidden source of calories in the consumer's diet. Excess sugar consumption is associated with several negative health conditions, such as obesity, tooth decay and non-communicable diseases (NCDs), such as diabetes, cancer, chronic respiratory diseases (e.g. asthma and chronic obstructive pulmonary disease), and cardiovascular diseases (e.g. stroke and heart attacks) (Oliveira *et al.*, 2016; Sharma *et al.*, 2016; World Health Organization [WHO], 2018). In South Africa more than half of the population is either overweight or obese (Herbst, 2019). It is, therefore, necessary to take action to reduce sugar consumption by providing consumers with lower sugar or sugar-free products (Judah *et al.*, 2020). However, taste is known to be the main factor in choosing food products (Belščak-Cvitanović *et al.*, 2015; Colares-Bento *et al.*, 2012), and consumers often perceive sugar-free or low-sugar products to have an unpleasant taste (Crofton *et al.*, 2013). This perception can be ascribed to the 25 TAS2R taste receptor gene, that is, taste receptors that cause sensitivity towards a bitter taste (Sandell *et al.*, 2018) – leading to the avoidance of bitter-tasting food (Eldeghaidy *et al.*, 2011; Herbert *et al.*, 2014; Roudnitzky *et al.*, 2015), such as sugar-free chocolate.

The study of emotions in consumer and sensory research has grown rapidly in the last ten years (Chaya *et al.*, 2015; Gunaratne *et al.*, 2019; Meiselman, 2015), as consumers' emotions contribute to a better understanding of their behaviour and food choices (Gutjar, Dalenberg *et al.*, 2015). Measuring consumers' emotional response to food products outperforms traditional sensory and acceptability measurements and can provide valuable information for product development and marketing (Thomson *et al.*, 2010; Torrico *et al*., 2018). The majority of research on sensory and consumer emotion has been conducted using self-reported measures because this technique is cost-effective and short in duration, although it often requires the consumer to use an emotional lexicon (Chaya *et al.*, 2015; Dorado *et al.*, 2016). An emotional lexicon is a collection of emotional terms associated with a specific product, which is then used to identify the consumer's emotional response (Gunaratne *et al.*, 2019).

In this study, consumers' emotional response was determined by developing an emotional lexicon for three taster status groups, based on the emotions they experience when tasting sugar-free chocolate. The results from this study are expected to reveal important information about consumers' emotional response to and taste experience, consumption and purchasing of sugar-free chocolate. These findings could contribute to the existing knowledge and

underexplored phenomenon of the link between consumers' emotions and their taster status of sugar-free products (Gunaratne *et al.*, 2019) in a South African context.

1.2 Background and motivation

1.2.1 Taste

Consumers are classified into three taster status categories according to their sensitivity to bitter taste (Ammann *et al.*, 2019; Yang *et al.*, 2018, 2019). These categories are non-tasters (NT), medium tasters (MT) and supertasters (ST) (Ammann *et al.*, 2019; Yang *et al.*, 2019). If consumers show sensitivity towards a bitter component, they tend to display this through their eating behaviour by avoiding eating foods such as broccoli, turnips and kohlrabi and the consumption of alcohol (Eldeghaidy *et al.*, 2011; Herbert *et al.*, 2014). Consumers who are sensitive towards a bitter taste show negative emotions and emotional responses towards food and beverages with a bitter compound (Ammann *et al.*, 2019). According to Yang *et al.* (2018), consumers' taster status influences their oral sensitivity, which can affect their food and beverage preferences and cause an emotional response. Therefore, as consumers differ according to their taster status, they perceive a specific product differently, and for this reason, it is worth investigating the association between consumers' emotions on sugar-free chocolate and their taster status. To date, little research has investigated how consumers' individual differences affect their emotional response towards food and beverages (Yang *et al.*, 2018).

1.2.2 Emotional response

An emotional response is an adaptive reaction to an eliciting stimulus, which includes action tendencies, behavioural or bodily responses and a change in subjective feeling (Brosch *et al.*, 2010). By measuring emotional response, researchers can better understand consumers' choices and behaviour of chocolate purchases (Kenney & Adhikari, 2016), which can gather valuable information that can be used in product development and marketing (Gunaratne *et al.*, 2019; Thomson *et al.*, 2010). Emotions can reveal previously unknown aspects of sensory profile and product attributes, which can be a valuable tool for the industry in product development and marketing (Russell, 2009). When producers have more knowledge of emotion profiles, consumers' emotional needs can be met by altering products to fit different market segments, product categories, and brand categories (Gutjar, Dalenberg *et al.*, 2015). Based on this, a product category map may then be developed to guide product development that relates to the brand essence, which will convey a powerful emotional aspect of the product (King *et al.*, 2010).

1.2.3 Chocolate

Chocolate is a well-known, enjoyable treat due to its unique sensory properties (Aidoo *et al.*, 2015; Saputro *et al.*, 2019). It is often consumed for comfort-eating and has a positive effect on one's emotions as it offers immediate enjoyment and pleasure (Paoletti *et al.*, 2012). In 2018, the chocolate confectionery retail consumption of South Africa was worth USD761,20 million (Poelmans & Swinnen, 2019). According to Mahomedy (2019), South Africa has a well-established chocolate confectionery market valued at R6,4 billion. South Africa does not produce its own cocoa; consequently, cocoa is imported from West Africa, which increases the price of chocolate (FoodStuff SA, 2016).

Consumers search for alternative food with a lower calorie count due to their busy lifestyles and their awareness of the risks associated with unhealthy lifestyles (Aidoo *et al.*, 2015). In the past years, the cocoa and chocolate industry has experienced changes because the market has been influenced by consumers' demands for healthier, lower sugar or sugar-free products that still taste good, are convenient and promote good health (Belščak-Cvitanović *et al.*, 2015; Rodriguez Furlán *et al.*, 2017; Sharma *et al.*, 2016; Vyas, 2011). According to Rodriguez Furlán *et al.* (2017), the use of low-calorie sweeteners is the solution for producing lower sugar or sugar-free products. With a lower sugar intake, one can reduce the risk of NCDs, ultimately leading to better health (Konar *et al.*, 2018). Thus, consumption of no- and low-sugar food products, including chocolate in this category, can help consumers live a healthier lifestyle.

1.3 Problem statement

Statistics show that 61% of the population living in South Africa is either overweight or obese (Herbst, 2019). These numbers will continue to grow (Gordan, 2016) if South Africans do not change their lifestyles by lowering their obesity level and sedentary lifestyle (Le Roux *et al.*, 2019). Excess sugar consumption leads to several health problems, including diabetes, tooth decay and overweight (Sharma *et al.*, 2016; WHO, 2016, 2017). Research shows that some consumers know the risks of an excessive sugar intake and an unhealthy lifestyle and, therefore, would like to improve their health and wellbeing (Giacalone, 2018) by reducing their sugar intake (Aidoo *et al.*, 2015; Sharma *et al.*, 2016). Numerous studies have been conducted on sugar consumption (e.g. Newens & Walton, 2015; Noble *et al.*, 2016; Peres *et al.*, 2016); however, limited research has been conducted on consumers' emotions and emotional response towards sugared food products, such as chocolate (Gunaratne *et al.*, 2019). In addition, very few studies have investigated how consumers' different taster statuses influence their emotions when consuming food products, especially sugar-free options.

Consumers want to enjoy the sensory properties of food products (Yang *et al.*, 2019), with taste being the main factor in choosing food products. Consequently, some consumers will rather choose “unhealthy” foods with a higher sugar content than sugar-free products (Crofton *et al.*, 2013). This is due to consumers’ general perception that while food products with reduced sugar content are healthier, they may taste unpleasant (Crofton *et al.*, 2013). Consumers also have the perception that sugar-free chocolate is only consumed when one has particular health issues, such as diabetes and weight problems (Belščak-Cvitanović *et al.*, 2015).

Due to those consumers that would like to move towards a healthier lifestyle, it is worth investigating their emotions concerning sugar-free chocolate and how their taster status influences these emotions. The researcher could not locate any research about emotional lexicons and their association with different taster statuses focusing on sugar-free products such as chocolate. It is, therefore, important that emotional lexicons are developed to assist the confectionery market in focusing on consumers as individuals, making it easier for consumers to choose healthier chocolate products while still enjoying their treat.

This study will serve as a baseline for future research on consumers’ taster status with regard to sugar-free products. The results will benefit the food industry, as the developed emotional lexicons can be used for product development to ensure that a product meets the needs of different consumers and potentially increases the success of the product (Crofton *et al.*, 2013). Consumers will also benefit from this study, as the confectionery market will see the importance of focusing on consumers’ taster status when developing sugar-free products. In return, consumers will have more sugar-free chocolate options to choose from that are applicable to their own tastes.

1.4 Research question, aim and objectives

1.4.1 Primary research question

How does consumers’ taster status influence their emotions with regard to sugar-free chocolate?

1.4.2 Aim

The aim of this study is to develop emotional lexicons for sugar-free chocolate based on consumers’ taster status (non-, medium and supertasters) using the check-all-that-apply (CATA) methodology.

1.4.3 Objectives

The objectives of the study are:

- to determine consumers' taster status;
- to determine consumers' consumption, purchasing behaviour and acceptance of sugar-free chocolate;
- to determine emotional lexicons for sugar-free chocolate for consumers with different taster statuses;
- to determine the association between emotional lexicons and consumers' taster status; and
- to describe the demographic characteristics of consumers.

1.5 Summary of methodology

A quantitative non-experimental, descriptive, cross-sectional study was conducted using a self-administered electronic questionnaire to collect quantifiable data. The study population consisted of 158 South African adult consumers. A non-probability convenience sampling method was used with inclusion and exclusion criteria. The inclusion criteria required respondents to be adults (≥ 18 years), be computer literate, understand the English language and enjoy consuming chocolate. Moreover, respondents with any known chocolate allergies of sensitivities to its ingredients were excluded from the study as they had to consume chocolate samples.

Respondents were recruited via social media platforms on which electronic posters were posted. Those interested in the study followed a link on the advertisement to be screened. A screening questionnaire had been developed to ensure that only respondents who met the inclusion criteria were part of the data collection process. Successfully screened respondents collected a sample bag containing two chocolate samples at a central location and received the main electronic questionnaire (QuestionPro©) link via e-mail. The main questionnaire consisted of five sections. The outlay of the questionnaire is presented in Table 1-1.

Data analysis for the electronic questionnaire was performed with the assistance of the Statistical Consultation Services (SCS) of the North-West University (NWU). Descriptive statistics analysis was used on the electronic questionnaire in order to draw conclusions from the data collected. For analysing the data, the IBM Statistical Package for the Social Sciences (SPSS) Version 26, Release 20.0 was used. The statistical analysis included the calculation of frequencies and percentages, means and standard deviations, phi and Cramer's V, and cross-tabulation.

Table 1-1: Outlay of the main questionnaire

Section in questionnaire	Scale or construct
A: PROP taster status test	Labelled magnitude scale (LMS): 1 being "barely detectable", to 100 being "strongest imaginable"
B: Taster status using bitter food products	5-point Likert scale: 1 = an extreme dislike, to 5 = extremely likeable
C: Chocolate consumption	5-point Likert scales:
Frequency of consumption	1 = daily; 2 = more than twice a week; 3 = twice a week; 4 = once a week; 5 = once a month or less
Reason for consumption	1 = for emotional satisfaction; 2 = to overcome hunger; 3 = regard it as healthy; 4 = as a habit; 5 = other reason (specify)
Purchase intention	1 = brand; 2 = flavour; 3 = price; 4 = packaging; 5 = other reason (specify)
Sugar-free chocolate Sensory acceptance (taste and aftertaste)	1 = dislike extremely, to 5 = like extremely
Purchase intention	1 = definitely would not buy, to 5 = definitely would buy
D: Emotional response	Emotional terms from EmoSensory® wheel: CATA
E: Demographic information	Multiple-choice questions: age, gender, hometown, province and location where questionnaire was completed

1.6 Conceptual framework

As previously mentioned, consumers are classified according to their taster status (Ammann *et al.*, 2019; Yang *et al.*, 2019). This taster status influences consumers' emotions and emotional response towards food products (Ammann *et al.*, 2019; Yang *et al.*, 2018, 2019). Consumers make use of their emotions to guide them when making purchasing decisions (Schifferstein & Desmet, 2010). Furthermore, consumers' taster status tends to influence their consumption and purchasing behaviour of food products. This was confirmed through sensory evaluation and emotional response with sugar-free chocolate. Chocolate is consumed as consumers get cravings or may be avoided due to feelings of guilt (Velarde *et al.*, 2018), and this affects their emotions and emotional response. For this study, consumers' taster status was tested to determine what influence it has on the consumption and purchasing of sugar-free chocolate through sensory evaluation and emotional response in order to develop an emotional lexicon for each taster status (see Figure 1-1).

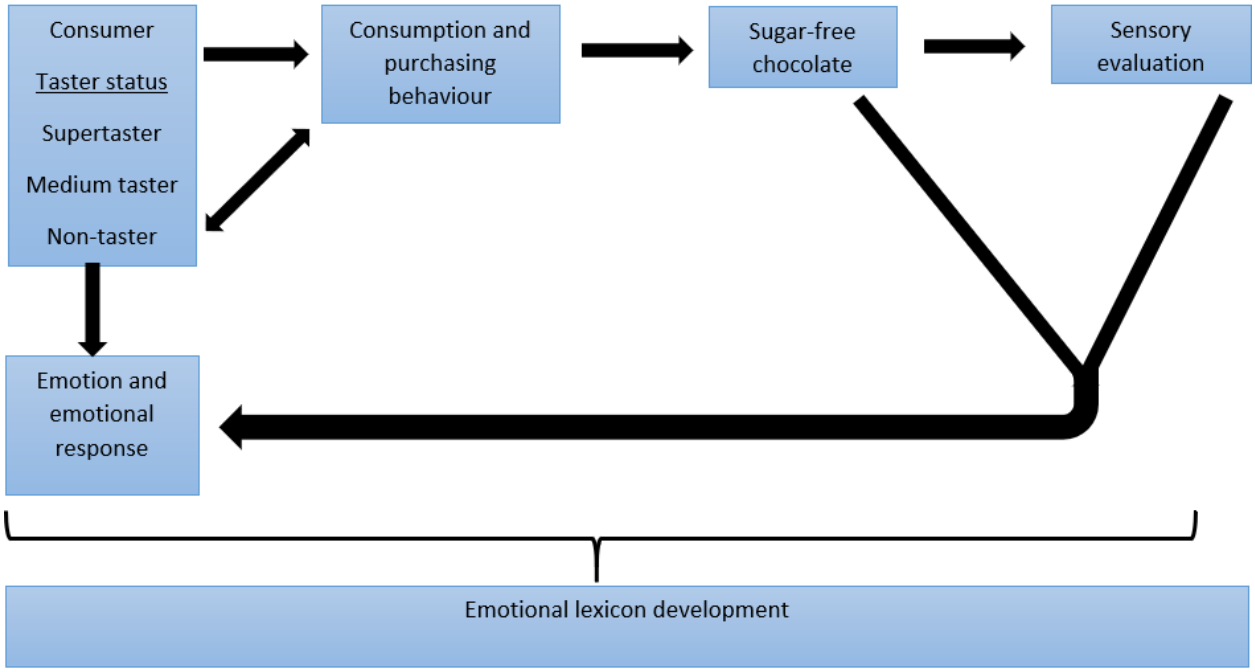

Figure 1-1: Conceptual framework to explore the relationship between concepts in the study

1.7 Concept clarification

Consumer: A person (individual) who consumes products and uses services for their own benefit and needs (Noel, 2017). For this study, a consumer is someone who has consumed chocolate at least once in the past year.

Taster status: Consumers are classified into three categories according to their ability to taste bitterness, which is determined by a gene, TAS2R38 (Roudnitzky *et al.*, 2015). Taster status is tested through the use of 6-n-propylthiouracil (PROP) (Herbert *et al.*, 2014).

Supertaster: The consumer finds PROP exceptionally bitter and does not like the taste thereof (Ammann *et al.*, 2019; Herbert *et al.*, 2014; Yang *et al.*, 2018).

Medium taster: The consumer finds PROP quite bitter (Ammann *et al.*, 2019; Herbert *et al.*, 2014; Yang *et al.*, 2018).

Non-taster: The consumer finds the PROP a little bitter or tasteless and does not mind the taste thereof (Ammann *et al.*, 2019; Herbert *et al.*, 2014; Yang *et al.*, 2018).

Consumption: Consumers' selection of what food and beverage they want to consume to fulfil their needs of hunger and thirst (Schiffman *et al.*, 2014).

Purchasing behaviour: Consumers' motivation to consume and purchase products according to their needs (Schiffman *et al.*, 2014). For this study, the focus will be on the consumption of and intention to purchase sugar-free chocolate.

Emotion: An individual's emotion (e.g. happy, sad or angry) towards a specific product (Thomson & Crocker, 2013).

Emotional response: A reaction to one's feelings that is accompanied by physiological changes that motivate action or behavioural response (Mosby, 2006).

Sugar-free chocolate: A cocoa-based treat with no or low sugar, which may contain sweeteners (Son *et al.*, 2018).

Sensory evaluation: Sensory evaluation measures consumers' response to food and beverages (Lawless, 2013; Singh-Ackbarali & Maharaj, 2014), focusing on sugar-free chocolate in this study.

Emotional lexicon: A collection of emotional terms that are associated with sugar-free chocolate, which will then be applied to identify respondents' emotional responses (Gunaratne *et al.*, 2019).

1.8 Structure of the dissertation

An overview of what each chapter entails follows below.

Chapter 1 consists of the introduction, background and motivation of the study. In addition, the problem statement, the aim and objectives, and the research question are discussed, serving as an introduction to the study and clarifying what the study aims to achieve. Each author's contribution to the study is presented as well.

Chapter 2 serves as a literature review of consumers' taster status and their sugar-free chocolate consumption and purchases. In this chapter, all the elements of consumers' taster status and consumers' behaviour regarding sugar-free chocolate are discussed.

In Chapter 3, the methodology that has been followed in the study is provided, and the different elements that have contributed to the execution of the research study are discussed. The validity and reliability of the study, as well as the ethical considerations that have guided the study, are set out.

In Chapter 4, the results and findings of the study are presented in accordance with the objectives of the study. The interpretation of the data is connected to the existing literature to compare the findings of the research.

The conclusion of the research is presented in the final chapter. Furthermore, recommendations for future studies and the limitations of this study are provided.

1.9 Authors' contributions

The contribution of each member in the research team is presented in Table 1-2 below.

Table 1-2: Summary of the authors' contributions to the study

Research member	Responsibility
Researcher: Miss T van Zyl	• Doing research, and writing the full dissertation. • Planning the research project by conducting a thorough and comprehensive literature review on the topics of the study, and creating a research question and objectives specific to the study to answer the research question. • Writing the methodology, compiling the questionnaire with guidance from the study supervisors and the statistician, and developing an electronic version for the respondents to complete. • The preparation of the material and samples, and designing the advertisement. • Working with the statistician to gather and analyse the data to address the objectives of the study. • Funding acquisition.
Supervisor: Prof A Mielmann	• Assisting and guiding the researcher, and making recommendations throughout the study. • Making sure that a suitable methodology is chosen and the collected data are correctly interpreted. • Ensuring that the research is conducted in an effective and timely manner. • Assisting in obtaining ethical clearance and funds to enable this research study. • Providing the researcher with scientific literature.
Co-supervisor: Dr N le Roux	• Assisting and guiding the researcher, and making recommendations throughout the study. • Making sure that a suitable methodology is chosen and the collected data are correctly interpreted. • Assisting in obtaining ethical clearance. • Providing the researcher with scientific literature.

The next chapter will present the reader with a literature review and elaborate on the concepts provided in the conceptual framework (see Figure 1-1).

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

Taste is a sensory modality involving the oral perception of food-derived substances that activate the receptor cells of taste buds (Breslin, 2013). Taste perception is an important factor for accepting or rejecting food products (Rozin, 1990). Humans' taste receptors can detect and discriminate between five taste qualities, namely sweet, sour, bitter, salty and umami (Kinnamon & Margolskee, 1996; Montmayeur & Matsunami, 2002; Zhao *et al.*, 2003). While some people's tongues are more sensitive to a bitter compound, others' are much less sensitive, which is known as "taste sensitivity" (Reed *et al.*, 2006). Taste sensitivity varies among consumers and can have a significant impact on their food preferences, health and nutritional status (Tepper, 2008). Consumers' everyday experience with food products and the taste compounds thereof create their conscious understanding of taste (England, 2019), as most consumers can detect and discriminate between the five taste qualities along with the intensity of taste.

Researchers have been able to confirm a definitive relationship that exists between consumers' bitter taste perception, emotions and behaviour (Ammann *et al.*, 2019; Breslin & Spector, 2008; Rozin, 1990; Thomson & Crocker, 2013). New discoveries on the impact of emotions on consumer behaviour have been reported in recent years, prompting increased interest from both the business and the general public to this phenomenon that is linked to sensory and affective interaction and consumers' emotions (Escadas *et al.*, 2019; Juodeikiene *et al.*, 2018; Köster & Mojet, 2015).

The anticipated emotions consumers may experience while consuming food products can contribute to the understanding of their behaviour towards a food product (Juodeikiene *et al.*, 2018). Moreover, an understanding of consumers' emotions can help the development of a marketing plan specific to a group of consumers, as it can determine the influencing factors and consumers' beliefs towards a food product (De Pelsmaeker *et al.*, 2017). The rise in attention to and interest in the measurement of emotion in consumer and sensory research have led to the development of emotional instruments such as the EsSense Profile™ (King & Meiselman, 2010), the EmoSemio questionnaire (Spinelli *et al.*, 2014) and the EmoSensory wheel (Schouteten *et al.*, 2015).

The global market for chocolate has grown rapidly in recent years, and it is expected that this growth will continue (Hu *et al.*, 2020; Li & Mo, 2016; Magelund, 2013; Neilson *et al.*, 2018). Chocolate is the most craved for and preferred of all sweet food products; this tendency is

seen more in female consumers, as they tend to enjoy chocolate more than male consumers (Durkin *et al.*, 2012; Herman & Polivy, 2010; Hormes *et al.*, 2014; Striegel-Moore *et al.*, 2009). Due to chocolate being high in sugar (sucrose and fructose) and fat, many consumers would like an alternative (sugar-free product) to live a healthier lifestyle (Botchway *et al.*, 2015; Sharma *et al.*, 2016; Vyas, 2011).

The WHO strongly recommends that adults and children should reduce their sugar intake to less than 10% of their total energy intake per day. A high intake of sugar leads to the concern of poor dietary quality, the risk of NCD and obesity (WHO, 2015). There are thousands of food products on the market with high sugar quantities, leaving the consumer tempted to consume these (Sharma *et al.*, 2016). While consumers may want to live a healthy lifestyle and are concerned about their weight and health (Sharma *et al.*, 2016; Vyas, 2011), they are still human and often would like to enjoy a treat (Yang *et al.*, 2019). However, recently, some consumers have been turning to sugar-free products, although they still want to enjoy the sensory properties in products, such as chocolate, that are mainly purchased for their flavour (Gunaratne *et al.*, 2019; Yang *et al.*, 2019). Products with no sugar or a low-sugar content are growing in the market, making it much easier for the consumer to maintain a healthier lifestyle (Aidoo *et al.*, 2015; Vyas, 2011). The most common approach to reducing or replacing sugar in food products is to use sugar substitutes, such as sweeteners (Sharma *et al.*, 2016). However, the use of sweeteners can add a bitter taste or aftertaste to food products (Calvino *et al.*, 2000). This causes a challenge for food manufactures, as consumers may reduce their sugar consumption but will not sacrifice the sweet-tasting properties of food products (Yang *et al.*, 2019).

In this chapter, a literature review provides an in-depth look at consumers' taste experience of sugar-free chocolate, the focus product of the study. A review is provided on the critical concepts of the study that include determining consumers' taster status, emotional response and the measurement thereof with an emotional lexicon, chocolate consumption and chocolate purchasing behaviour, as well as the socio-demographic characteristics that have an influence on consumers' taster status and chocolate consumption and purchasing behaviour. Furthermore, the health effects of sugar consumption and the way sensory evaluation can be used to measure consumers' response to sugar-free chocolate are addressed. This review includes both recent and older references. The theoretical information that comes from older references is of significant importance as it provides the foundation of the empirical findings for the recent research that has been done on the study variables. In a few cases, the older references serve as empirical findings due to the constructs being investigated and reported on years ago.

2.2 Consumers' taste experience

Taste can be described as a chemosensation that is perceived on the tongue and is provoked by chemical compounds found in food and beverages (Taruno *et al.*, 2021). Taste is organized by taste buds that are multicellular and located on the tongue and palate (AlJulaih & Lasrado, 2020). Taste buds are groups of neuroepithelial receptor cells located in the epiglottis' stratified epithelium, tongue and palate (Roper & Chaudhari, 2017). The human tongue has four types of papillae; foliate, fungiform and circumvallate papillae are taste buds containing papillae, while filiform papillae transduce touch, temperature and nociception (AlJulaih & Lasrado, 2020; Barlow, 2015; Barlow & Klein, 2015; Gravina *et al.*, 2013; Liu *et al.*, 2016; Melis *et al.*, 2020). The anatomy of the human tongue and taste buds is shown in Figure 2-1.

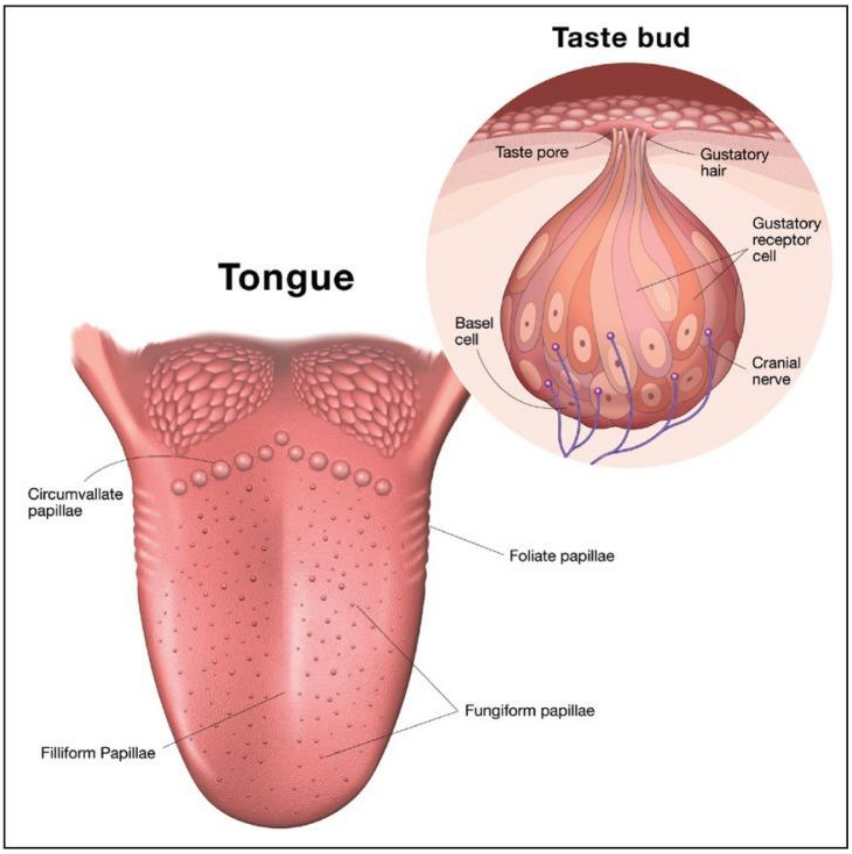

Figure 2-1: Human tongue anatomy of papillae and taste buds (Gravina *et al*., 2013)

Fungiform taste buds papillae are mushroom-shaped structures, of which humans have, on average, 195 that are located in the anterior two-thirds part of the tongue (AlJulaih & Lasrado, 2020; Gravina *et al.*, 2013). The amount of fungiform papillae that are presented on the dorsal surface of the tongue can influence a consumer's taster status (Varghese, 2018). Circumvallate taste buds papillae are V-shaped, bigger and more complex compared to the other papillae and are located in the posterior third of the tongue (AlJulaih & Lasrado, 2020;

Barlow, 2015). The circumvallate papillae of the human body have more than 100 taste buds (Gravina *et al.*, 2013). On the lateral sides of the tongue are the foliate taste buds papillae that contain over 100 taste buds (AlJulaih & Lasrado, 2020; Gravina *et al.*, 2013). The non-taste papillae of the tongue called the filiform papillae make up the majority of the tongue, containing sensory nerve endings that enable one to feel temperature, pain, and texture (AlJulaih & Lasrado, 2020; Gravina *et al.*, 2013).

Tasting is caused by a chemical known as "tastant", which is located at the apical tips of taste bud cells (Roper & Chaudhari, 2017; Taruno *et al.*, 2021). Taste buds typically contain between 50 and 100 tightly packed taste receptor cells that can detect tastants (Di Pizio *et al.*, 2019; Lee *et al.*, 2017; Liu *et al.*, 2016; Loper *et al.*, 2015; Melis *et al.*, 2020). Taste sensations can be classified into five groups based on the quality of the taste sensation: bitter, salty, sour, sweet, and umami (Di Pizio *et al.*, 2019; Loper *et al.*, 2015; Roper & Chaudhari, 2017; Taruno *et al.*, 2021). It has been found that all five basic tastes can be perceived equally well on all parts of the tongue, although the sensitivity (detection threshold) can vary and the back of the tongue is extremely sensitive to bitter tastes (Cavazzana *et al.*, 2019; Informed Health, 2016).

Five distinct cell types of taste bud cells have been identified, namely type I cells, receptor (type II) cells, presynaptic (type III) cells, basal cells and neuronal processes (AlJulaih & Lasrado, 2020; Gravina *et al.*, 2013; Liu *et al.*, 2016; Melis *et al.*, 2020; Roper, 2013; Taruno *et al.*, 2021). Type I cells have apical granules of electron-dense cytoplasm that resemble glial cells (AlJulaih & Lasrado, 2020; Liu *et al.*, 2016; Melis *et al.*, 2020). Type II cell is characterized by a spindle-shaped nucleus with short microvilli and large microvilli that emerge at the apical region (Liu *et al.*, 2016). Type II cells express G-protein-coupled taste receptors for bitter cells, umami and sweet, depending on the specific molecules on the apical membrane that seems to express taste receptors (AlJulaih & Lasrado, 2020; Liu *et al.*, 2016; Melis *et al.*, 2020; Taruno *et al.*, 2021). Umami and sweet and taste sensations are detected by the G-protein-coupled receptors T1R1, T1R2 and T1R3 in homodimeric or heterodimeric complexes (Li *et al.*, 2019; Taruno *et al.*, 2021). The bitter taste is regulated by the "T2Rs" family of G-protein-coupled receptors, of which humans have 25 T2R functional genes in humans (Li *et al.*, 2019; Roper & Chaudhari, 2017; Taruno *et al.*, 2021). Consumers' bitter perception differs due to their genetic variations, as they consist of the taste receptor TAS2R38 (taste 2 receptor) gene family (Roudnitzky *et al.*, 2015) as well as the amount of fungiform papillae that are presented on the dorsal surface of the tongue (Varghese, 2018).

Type III cells have large vesicles in the nuclear region, are slender in shape with a single microvillus that protrudes into the taste pore (Liu *et al.*, 2016). Type III cells respond to sour taste and form conventional vesicular synapses with afferent nerves (AlJulaih & Lasrado,

2020; Liu *et al.*, 2016; Taruno *et al.*, 2021). The primary stimulant for sour-sensing type III cells is the extracellular and intracellular protons as a result of hydrogen ions, releasing chemicals (e.g. acids) that serve as sour tastants (Taruno *et al.*, 2021). The role of the basal or type IV cells is uncertain since they appear to be undifferentiated or immature (Liu *et al.*, 2016). Cells that transduce the salty taste are known as “unclassified taste cells” in terms of these types of taste cells (Gravina *et al.*, 2013; Roper, 2013; Taruno *et al.*, 2021).

2.3 Consumers’ taster status

Propylthiouracil (PROP) taster status is known as the degree to which consumers can perceive a bitter taste. Consumers are classified according to their taster status based on the intensity rating towards PROP (Herbert *et al.*, 2014; Varghese, 2018). ST have high sensitivity to bitter taste, MT have moderate sensitivity and NT have low or no sensitivity. ST perceive PROP to be extremely bitter and have a higher density of fungiform papillae on their tongue surface compared to MT and NT (Ammann *et al.*, 2019; Barberini *et al.*, 2019; Yackinous & Guinard, 2002a). Studies have found that STs tend to dislike sweet food and NT tend to like sweet food (Hegde & Sharma, 2008; Looy & Weingarten, 1992). Approximately 25% of the population is classified as ST, 50% as MT and 25% as NT (Mezzavilla *et al.*, 2019; Spence, 2019).

Different studies have been done on consumers’ taster status focusing on the consumers’ perception of a bitter taste in various products. These products include caffeine (Hall *et al.*, 1975), coffee and grapefruit juice (Lanier *et al.*, 2005), quinine (Gent & Bartoshuk, 1983; Hayes *et al.*, 2008), alcoholic beverages (Intranuovo & Powers, 1998), beer (Mela, 1990; Yang *et al.*, 2018), soy products and green tea (Akella *et al.*, 1997), broccoli, kohlrabi, turnips and alcohol (Duffy & Bartoshuk, 2000; Eldeghaidy *et al.*, 2011; Tepper & Nurse, 1997) and brassicaceous vegetables (Drewnowski & Gomez-Carneros, 2000; Gorovic *et al.*, 2011). A classification of taster status is discussed in the following section.

2.3.1 Supertasters

ST can be defined as consumers that have more than 30 taste buds on their tongue (England, 2019). A higher number of fungiform papillae and functional taste buds are also located on the apex of the tongue, explaining ST increased sensitivity to bitter tastes (Khan *et al.*, 2019; Yeomans *et al.*, 2007). Studies have found that women have more taste buds and fungiform papillae compared to men; therefore, women are more likely to be ST (Bartoshuk *et al.*, 1994; Drewnowski *et al.*, 1998; Spence, 2019). ST dislike bitter-tasting food and beverages and avoid alcohol consumption (Ammann *et al.*, 2019; Herbert *et al.*, 2014; Yang *et al.*, 2018).

However, a recent study by Yang *et al.* (2018) found that ST and MT significantly liked beer more than NT.

Based on previous findings, ST have a higher sensitivity to and lower preference for various oral stimuli than NT (Melis *et al.*, 2020), including bitter compounds (Bartoshuk *et al.*, 1992), sweet substances (Yeomans *et al.*, 2007), sour compounds (Prescott *et al.*, 2004), the umami taste (Melis & Barbarossa, 2017), irritants (Duffy *et al.*, 2004; Prescott & Swain-Campbell, 2000), high-fat or high-energy food (Kirkmeyer & Tepper, 2003; Melis *et al.*, 2015), astringent substances (Melis & Barbarossa, 2017) and fruit and vegetables (Bell & Tepper, 2006; Mezzavilla *et al.*, 2019). Drewnowski (2004) has found that ST tend to be slender compared to NT who tend to be heavier in weight; this can be due to ST sensitivity to and lower preference for the above-mentioned oral stimuli. Due to salt masking the bitter taste, ST tend to consume more sodium compared to MT and NT (Hayes *et al.*, 2010; Nahar *et al.*, 2018).

2.3.2 Medium tasters

MT have between 15 and 30 taste buds on their tongue (England, 2019) and will, to a lesser extent, dislike food products that are bitter, strong tasting and spicy compared to ST (Betancur *et al.*, 2020; Catanzaro *et al.*, 2013). Tepper and Nurse (1997) investigated the relationship between taster status and a preference for fatty foods among college students and found that MT and ST could distinguish low-fat salad dressings from high-fat salad dressings. A study was done among school children, and the results showed that the majority of the female respondents were MT, and the MT and ST consumed sweets at a lesser frequency, had fewer snacking habits and consumed fewer soft drinks compared to NT (Krithi *et al.*, 2020).

2.3.3 Non-tasters

NT have fewer than 15 taste buds on their tongue (England, 2019). They tend to have a preference for strongly flavoured foods, such as hot, spicy foods (Catanzaro *et al.*, 2013; Hayes *et al.*, 2010). Bell and Tepper (2006) investigated taster status in children's selection of vegetables as a snack. They found that NT chose bitter vegetables and showed a higher preference for raw broccoli compared to children who were MT or ST. Similar findings were reported in other studies for various vegetables and bitter-tasting foods (Drewnowski & Gomez-Carneros, 2000; Kaminski *et al.*, 2000). More recently, a study found that vegetable consumption was lower among NT compared to both MT and ST in a buffet setting, which suggests that in the presence of highly palatable foods, such as a buffet, NT prefer to consume energy-dense, high-fat foods rather than healthy foods, such as fruit and vegetables (Shafaie *et al.*, 2013). This finding is supported by the study of Hayes and Duffy (2007), which has

found that NT have a reduced ability to differentiate between the fat content of foods. Also, NT tend to show the greatest alcohol intake and have a higher rate of alcoholism compared to ST and MT (DiCarlo & Powers, 1998).

2.3.4 Determining consumers' taster status

There are a few methods that can be used to determine a consumer's taster status, such as the use of impregnated paper screening tests, PROP solution or PROP test paper strips (Tepper *et al.*, 2001; Zhao *et al.*, 2003). With the impregnated paper screening test, respondents are asked to hold two paper disks impregnated with sodium chloride (NaCl) (1,0 mol/l) and PROP solution (50 mmol/1) on the tip of their tongue for 30 seconds, respectively (Barbarossa *et al.*, 2015; Sollai *et al.*, 2017; Zhao *et al.*, 2003). PROP solution (0,32 mM) is made by dissolving PROP in water on a stirring plate on low heat. The respondents should then roll a saturated cotton bud on the tip of their tong for three seconds (Yang *et al.*, 2019). For the PROP paper strip test, a paper strip is impregnated with a PROP solution. All of these methods make use of a LMS that was developed by Green *et al.* (1993), where the respondents can rate the intensity of the PROP bitterness on a 100-mm scale, with descriptors ranging from "barely detectable – 0" to "strongest imaginable – 100" (Barbarossa *et al.*, 2015; Sollai *et al.*, 2017; Yang *et al.*, 2019; Zhao *et al.*, 2003). Some consumers find PROP bitter, while others find it tasteless (Ammann *et al.*, 2019). If consumers find PROP bitter or tasteless, they are classified as NT; if they find it quite bitter, they are classified as MT; and if they find it exceptionally bitter, they are classified as ST (Ammann *et al.*, 2019; Herbert *et al.*, 2014; Yang *et al.*, 2018). Consumers are sensitive towards bitter taste tend to display negative emotions and emotional responses towards food and beverages with a bitter compound (Ammann *et al.*, 2019).

2.4 Emotion

King and Meiselman (2010) define "emotion" as a brief, intense mental and physiological reaction that is focused on a referent. "Emotion" is also defined as a response to something specific that is rapid, intense and short lasting (Ferrarini *et al.*, 2010b). Emotions are essential and crucial to understand consumer product conceptualization, product differentiation, and consumer choice prediction (Antonetti, 2020; Kenney & Adhikari, 2016; Prescott, 2017). This is due to emotion being acknowledged as a fundamental concept for consumers' choices (Thomson & Crocker, 2013). Emotion plays a crucial part in social interaction while regulating most of the activities of consumers, from conversations to business transactions and food consumption (Juodeikiene *et al.*, 2018).

According to King and Meiselman (2010), consumers assess products on both their physical aspects (external aspects, e.g. brand, label and package) and their emotion-evoking components (internal aspects, e.g. how they feel when consuming the product). When consumers use products, emotions are evoked by the aspects and properties of the products (Schifferstein & Desmet, 2010). One's emotion towards a product is influenced by the preference for the product, the perception, sensory experience, liking and brands of the product and attitudes, moods and feelings towards the product (Gunaratne *et al.*, 2019; Jaeger, Cardello *et al.*, 2013; Spinelli *et al.*, 2014). Therefore, when consumers are asked how they felt during or immediately after being exposed to a product, it can be assumed that the product elicited an emotion (Meiselman, 2015). Exposure to food products can be presented to respondents in different ways, such as branded or unbranded, with or without the packaging and tasted or not tasted (Khan & Lee, 2020; Skaczkowski *et al.*, 2016). A study in which the EsSence profile (measures consumers' overall acceptability of and emotions with regard to products) was used yielded different results on emotional profiles in a blind tasting with packaged and unpackaged products in taste conditions (Gutjar, Dalenberg *et al.*, 2015). A sample can, to some extent, provoke different emotions from respondents, depending on a blind test (packaged and unpackaged) (Gutjar, Dalenberg *et al.*, 2015).

There are three categories of emotions, namely positive (e.g. good, confident and loving), negative (e.g. bored, disgusted and worried) and unclassified emotions (e.g. aggressive, daring and wild) that consumers can experience (Gunaratne *et al.*, 2019). Consumers make use of their emotions, which can be either good or bad, to guide them in their decision making (Schifferstein & Desmet, 2010). When consumers feel a positive emotion towards a food product, they will be pulled towards the beneficial stimuli; if a negative emotion is felt, they will pull away from the stimuli (Schifferstein & Desmet, 2010).

2.4.1 Emotional response

"Emotional response" is known as a reaction to one's feelings that is accompanied by physical changes that provoke an action or a behavioural response (Mosby, 2006). Research on emotional response is a growing field, as information can be gathered from consumers' emotions about a specific product (Jaeger, Cardello *et al.*, 2013). It is known to be difficult to capture, measure and quantify emotions, since they are non-cognitive in nature, and what contributes to this, is the fact that consumers cannot always identify the cause of the emotion or even the emotion itself (Kenney & Adhikari, 2016). Currently, a few types of methods are used to measure emotions, namely physiological methods, facial recognition methods and self-reported measurement (Kenney & Adhikari, 2016).

Physiological methods are used when emotions are measured through the use of skin conductance, facial electromyography and face reader software (Hadinejad *et al.*, 2019). When measuring emotional response, consumers often make use of self-report methods, as these have the benefit of being short processes to gather information and being low in cost (Dorado *et al.*, 2016). There are two categories of self-reported measurement, namely visual and verbal techniques (Dorado *et al.*, 2016).

Visual self-report methods are based on images representing several emotions with which consumers express feelings (Dorado *et al.*, 2016; Kenney & Adhikari, 2016). Due to emotions being intuitive, pictures can be used to establish true emotional responses, as they limit the process of cognitive or rational thinking that is necessary to understand verbal cues (Jaeger, Cardello *et al.*, 2013). Examples of visual measurement methods are the Self-Assessment Manikin and the PrEmo and Image Measurement of Emotion and Texture (Bradley & Lang, 1994; Collinsworth *et al.*, 2014; Desmet & Schifferstein, 2008). Verbal self-report methods make use of consumers to evaluate their feelings using a list of words (Dorado *et al.*, 2016). Food-evoked emotion research is mostly based on reporting subjective experiences, with questionnaires as the most common questionnaires used to assess emotional responses (Kenney & Adhikari, 2016).

The information gathered through emotional response can be used for product development or marketing to develop products for target consumers and to do advertising for specific groups of consumers (Giacalone, 2018; Jaeger, Cardello *et al.*, 2013). Schouteten *et al.* (2018) investigated consumers' emotions towards chocolate and found that consumers reported to have mostly positive emotions when consuming chocolate. Preliminary work by Gunaratne *et al.* (2019) focused on the development of emotional lexicons to describe chocolate using the CATA methodology across Asian and Western groups. The results revealed that consumers differed across cultures when tasting chocolate and that different emotional lexicons were needed for different cultures and for milk and dark chocolate, as the emotions evoked by food could vary, based on culture, the tradition, time of day and the situation (Chrea *et al.*, 2009; Labbe *et al.*, 2009).

2.4.2 Emotional lexicons

An "emotional lexicon" is defined as "words with which the different forms of emotive and affective experiences are identified, isolated, and distinguished in the various human languages" (Sini *et al.*, 2014). Several emotional lexicons are being used in verbal self-reports, for example the EsSense Profile™ (King & Meiselman, 2010), the EmoSemio questionnaire (Spinelli *et al.*, 2014) and the EmoSensory wheel (Schouteten *et al.*, 2015). The EsSense

Profile™ is a questionnaire that contains a list of single words that describe emotional or feeling responses to foods (Kenney & Adhikari, 2016). The questionnaire asks respondents to rate 39 emotions (consisting of 25 positive, three negative and 11 uncategorised words) on a five-point scale (King & Meiselman, 2010). The EmoSemio questionnaire uses full sentences instead of single adjectives and reduces the list of emotions from 39 to 23 items (Spinelli *et al.*, 2014). EmoSensory is a wheel-based questionnaire combining emotional and sensory assessment; respondents rate intensity of identified terms (Schouteten *et al.*, 2015).

Using pre-determined emotional lexicons like EsSense Profile™ has the advantage of being general and can be applied to any group of products without the initial cost of developing product-specific lexicons (Chaya *et al*., 2015). However, some emotional terms may be irrelevant resulting in an unnecessary long list of emotions that can confuse respondents (Jaeger, Cardello *et al.*, 2013). Please see Section 3.7.1.5.1 for factors that should be considered when developing emotional lexicons.

2.4.3 Check-all-that-apply

The check-all-that-apply (CATA) method is known to be a fast and simple sensory profiling tool (Alexi *et al.*, 2018). The CATA methodology is used to obtain an appropriate lexicon for food products and can then be implemented to assess liking (Ares *et al.*, 2010; Dooley *et al.*, 2010). CATA is proven to be an efficient method to evaluate emotions that are linked with food products (Ares *et al.*, 2010; Perrin *et al.*, 2008). CATA has gained popularity as a result of its easy structure, low cognitive effort, and quick elicitation of sensory qualities in products (Ares *et al.*, 2011). Prior research has shown that data collected using CATA questions are trustworthy (Ares *et al.*, 2014). Also, CATA is utilized in sensory research because it can generate detailed, discriminative data (Jaeger *et al.*, 2018). In addition to this, by using only one question, CATA can collect a large number of frequency data, and consumers usually find it easy to use this method when completing questionnaires, as they can choose the terms that they feel are relevant instead of rating terms that may not be relevant to them (Gunaratne *et al.*, 2019).

2.5 Chocolate consumption

Food and beverage consumption is closely linked to consumers' health and wellbeing (Giacalone, 2018). Del Prete and Samoggia (2020) have found that there are specific determinants for chocolate consumption and chocolate purchasing behaviour, which include personal preference (health and taste), product attributes (packaging, brand, size and country

of origin), economic attributes (price and promotion) and socio-demographic factors (income, age and gender).

Consumers may consume chocolate when they get cravings, or they may avoid consuming chocolate due to guilt (Velarde *et al.*, 2018). The consumption of chocolate differs from consumer to consumer, although there are some reasons why consumers will consume chocolate, such as the gathering of friends and family on a holiday, a gift one has received or to improve one's mood, as chocolate is often associated with happiness, among other feelings (Paoletti *et al.*, 2012; Velarde *et al.*, 2018). A study by Macht and Dettmer (2006) confirmed that chocolate increased consumers' mood and energy levels five to 30 minutes after eating it. Furthermore, chocolate may be consumed due to indulgence or consumption-induced emotional changes, such as reducing one's hunger or elevating one's mood (Macht & Dettmer, 2006).

Another study by Parker *et al.* (2006) found that consumers regarded the consumption of chocolate to be pleasurable, relaxant, aphrodisiac and an antidepressant. It was also claimed that chocolate interacted with an individual's neurotransmitter systems, which resulted in consumers feeling good and their spirits being lifted. This suggests that chocolate can have a beneficial impact on a consumer's emotions (Paoletti *et al.*, 2012), as the consumption of chocolate is associated with joy and pleasure. Consumers see chocolate as a stress reliever. This is due to the cocoa polyphenols in chocolate that are assumed to lower stress (Velarde *et al.*, 2018). Macht and Mueller (2007) have found that the consumption of chocolate instantly affects a negative mood, although it has a low impact on neutral or positive moods, with palatable products (milk chocolate and dark chocolate with a low cocoa content) having a higher efficiency than unpalatable products (85% or 99% cocoa chocolate). Moreover, it has been shown that when consumers are stressed, they tend to consume more sweet, high-fat products (Oliver *et al.*, 2000), as negative emotions can often be measured by eating sweet foods (Macht *et al.*, 2005).

2.6 Chocolate purchasing behaviour

According to marketing research firm Nielsen (2014), chocolate is the most consumed snack in the world. It is estimated that the chocolate market will grow at a compound annual growth rate of 2,3% from 2014 to 2019 and that by 2020, the demand for chocolate will have grown by 30% (Beg *et al.*, 2017; Imarcgroup, 2021; More, 2021), making the consumption of chocolate a growing market. Chocolate is seen as an accessible luxury item (Mundel *et al.*, 2017) that consumers use to treat themselves for personal gratification (Poelmans & Rousseau, 2016). Despite the importance of taste to chocolate purchasing, the act of

purchasing is impulsive and is determined by an implicit mechanism without conscious awareness (Del Prete & Samoggia, 2020), as consumers do not want to compromise on the taste of chocolate (Thaichon *et al.*, 2018). These results are also supported by the study of Romaniuk and Nenycz-Thiel (2014), which concluded that taste was dependent on the consumer's choice, past habits and current emotion when purchasing chocolate. Consumer behaviour towards food and beverages is seen as a highly complex phenomenon with several external and internal influences (Hartwell *et al.*, 2016).

2.6.1 External factors that influence chocolate purchases

Kozelová *et al.* (2014) have found three main factors that affect consumers' chocolate purchases, namely recommendations of friends and acquaintances, the chocolate brand and the price. While the price of chocolate can influence consumers' purchasing behaviour, discounts and promotions can drive their chocolate purchasing habits (Del Prete & Samoggia, 2020). In addition, consumers feel that promoting chocolate unknowingly may persuade them to purchase it (Thaichon *et al.*, 2018). According to Davis and Millner (2005), consumers will switch between chocolate brands in order to benefit from sales promotions. Thaichon *et al.* (2018) argue that packaging plays an important role in chocolate purchasing behaviour, as chocolate is often purchased as a gift, and if a product is unfamiliar to consumers, they will choose the product with the most pleasant packaging.

2.6.2 Internal factors that influence chocolate purchases

Patwardhan *et al.* (2010) have found that psychological factors such as motivation, perception, beliefs, education, personality and attitude can affect consumers' behaviour. Consumers are motivated to purchase and consume chocolate due to the association thereof with a festive situation and the recurrence that occurs with friends and family, which are emotional (Paoletti *et al.*, 2012). Askegaard *et al.* (2013) have found that consumers' mood or psychological state can have an impact on what they may decide to purchase and consume. This finding is supported by Luomala *et al.* (2009), who have found that chocolate consumption is based on mood. Many experts believe that attitude is an important tool to understand consumer behaviour, as behaviour is to a great extent determined (Frymier & Nadler, 2007) by consumers' state of mind or feelings towards an object, that is, their attitude towards it (DeFleur & Westie, 1958; Walters & Paul, 1970; Wilkie, 1994). Consequently, attitude predicts behaviour (Frymier & Nadler, 2007).

The main internal factor on which this study will focus is the perception of taste. Taste is an important factor in consuming and purchasing chocolate (Del Prete & Samoggia, 2020).

However, the perception of taste is extremely personal (Thaichon *et al.*, 2018; Weiss *et al.*, 2010) and remains the key factor that influences consumers' chocolate purchasing behaviour (Ahmed *et al.*, 2012; Poelmans & Rousseau, 2016; Thaichon *et al.*, 2018).

2.7 Socio-demographic influence on taster status and chocolate

Socio-demographic characteristics, such as age, gender and income, can also influence consumers' chocolate purchasing behaviour (Del Prete & Samoggia, 2020). Gender and age are discussed in detail below as well as the taste and after taste of chocolate.

2.7.1 Gender

Garneau *et al.* (2014) conducted a research study with more than 400 individuals and found that women were more likely to be ST compared to men. Men's sensitivity to PROP has been found to decline at a faster rate than women's at the age of 20 years and older (Hong *et al.*, 2005). Anatomical data support this gender difference due to the fact that female consumers have more fungiform papillae and more taste buds than male consumers (Khan *et al.*, 2019; Prutkin *et al.*, 2000). The reason for this anatomical difference is not known, but it could be due to different dietary habits, alcohol consumption, smoking behaviour and hormonal factors (Prutkin *et al.*, 2000; Yamauchi *et al.*, 2002).

Studies have found that women have a more frequent, intense craving and elevated guilt for chocolate compared to men (Durkin *et al.*, 2012; Herman & Polivy, 2010; Hormes *et al.*, 2014; Striegel-Moore *et al.*, 2009). These results are supported by prior studies that have been done (Durkin *et al.*, 2012; Herman & Polivy, 2010; Striegel-Moore *et al.*, 2009). There is evidence that male consumers are more likely to crave savoury foods than sweet foods (Pelchat, 1997). It has also been found that men consume fewer food products under stress, while women consume more (Grunberg & Straub, 1992). Results have shown that female consumers also tend to purchase chocolate bars more often than their male counterparts (52% vs 38%) (Lybeck *et al.*, 2006).

2.7.2 Age

A study has found that consumers have a gradual increase in their taste sensitivity up to the age of 16 to 20 years, and it is then followed by an exponential decline (Glanville *et al.*, 1964). Doty *et al.* (2017), support this by stating that older consumers cannot make fine taste distinctions due to their taste function declining with age. Lybeck *et al.* (2006) have found that consumers from the age of 14 and younger and consumers between the ages of 15 and 44 years purchase chocolate bars once or many times a week, whereas consumers aged 45

years and older tend to purchase chocolate bars seldom or only a few times a month. Sondhi and Chawla (2017) argue that older consumers prefer to purchase and consume foreign chocolate brands, while younger consumers prefer to purchase and consume national chocolate brands.

2.7.3 Taste and aftertaste of chocolate

2.7.3.1 Conventional chocolate

Chocolate is a high-sugar, high-calorie food with a unique taste and texture due to a combination of cocoa solids, cocoa butter and sugar (Brown *et al.*, 2008; Rezende *et al.*, 2015). Typical dark chocolate consists of non-fat cocoa solids, fat (cocoa butter or butterfat), sugar and emulsifier (Brown *et al.*, 2008). Milk chocolate contains between 20 and 25% cocoa, with cocoa butter, sugar, milk powder and lecithin (Verna, 2013). It should have a shiny appearance, with a smell of vanilla, milk and cocoa, and the taste should be sweet, with a slightly bitter note due to the cocoa (Verna, 2013). Typical white chocolate consists of milk solids or milk powder, fat, sugar, emulsifier and vanilla (Brown *et al.*, 2008; Verna, 2013). Chocolate can also contain many other ingredients, such as flavourants (e.g. vanilla) and inclusions such as dried fruit, toffee, nuts and biscuit pieces (Brown *et al.*, 2008).

2.7.3.2 Sugar-free chocolate

Although consumers want to consume healthier food products (Sharma *et al.*, 2016; Vyas, 2011), they are not interested in consuming food products with noticeable off-flavours that they find unpleasant due to changes in the ingredients. Even though it has additional health benefits, such as lowering the risk of NCDs, obesity, tooth decay and type 2 diabetes (Luckow & Delahunty, 2004; Sharma *et al.*, 2016; WHO, 2016, 2017) taste remain an important factor for food consumption. Therefore, it is important that products that are developed with less or no sugar have as few differences as possible from regular food products (De Melo *et al.*, 2009). For example, cocoa, a main ingredients used in the production of chocolate, is known to have an intense bitter taste; therefore, non-nutritive sweeteners are often added (Son *et al.*, 2018) to give the chocolate a sweet taste and make it a healthier option compared to chocolate containing sugar. As the market is offering more sugar-free chocolate bars, consumers can still enjoy chocolate without feeling guilty, as the chance of obesity is reduced (Belščak-Cvitanović *et al.*, 2015; Rodriguez Furlán *et al.*, 2017).

The sugar-free chocolate bars that are on the market provide a variety of quality levels and are more diverse in terms of texture, flavour, taste and appearance dissimilar to those of their sugar-containing counterparts (Aidoo *et al.*, 2013). Rezende *et al.* (2015) conducted a study

with sucrose-free chocolate and found that consumers showed a positive correlation with the chocolate flavour and sweet taste but also a negative correlation with the bitter taste and aftertaste of this chocolate.

2.8 Sweeteners

The most common approach to reducing or replacing sugar in food products is to use sugar substitutes, such as sweeteners. Nutritive (e.g. poly alcohols/sugar alcohols and hydrogenated starch hydrolysates) and non-nutritive (e.g. acesulfame-K, alitame aspartame, cyclamate, erythritol, neotame, saccharin, stevia or steviol glycosides, sucralose and thaumatin) sweeteners are used. Sweeteners are substances that have a highly palatable taste and are used instead of sugar or sucrose to replace the sweetness of products (Aidoo *et al.*, 2013; Kroger *et al.*, 2006). As sugar has disadvantages for consumers' health the trend to use non-nutritive sweeteners is growing, as life expectancy is steadily increasing and consumers want to improve their health and wellbeing (Giacalone, 2018; Son *et al.*, 2018). Sweeteners are used in food products, as they are essentially calorie-free, but using some of these sweeteners can have an impact on food products and beverages as they may cause undesirable flavours and aftertastes, such as bitterness (Belščak-Cvitanović *et al.*, 2015; De Melo *et al.*, 2009).

Sugar alcohol (e.g. maltitol, xylitol, isomalt, mannitol and sorbitol) (Belščak-Cvitanović *et al.*, 2015; Koh *et al.*, 2018) and stevia (a steviol glycoside) that are incompletely digestible are being used in sugar-free chocolate to give consumers a sweet taste while having the advantage of low or no calories compared to chocolate with sugar (Aidoo *et al.*, 2015; Belščak-Cvitanović *et al.*, 2015; Koh *et al.*, 2018). The disadvantage of using sugar alcohol and stevia in chocolate is that they can have a bitter taste or aftertaste (De Melo *et al.*, 2009; Zorn *et al.*, 2014) and can have an effect on the texture of the chocolate, as sugar has a structural function in chocolate (De Pelsmaeker *et al.*, 2017).

2.8.1 Stevia

Stevia rebaudiana Bertoni is a small perennial subtropical plant (growing up to 65-80 cm tall) from which the product is extracted from the leaves of the plant and used as a sugar replacement (Goyal *et al.*, 2010; Shah *et al.*, 2010). Due to stevia being much sweeter (100-300 times) than sucrose, only a small amount (one cup of granulated sugar = ¼ teaspoon stevia) is needed to get the same level of sweetness (Goyal *et al.*, 2010; Shah *et al.*, 2010; Son *et al.*, 2018). Stevia does not have neurological or renal side effects and has anti-fungal and anti-bacterial properties; as a result, it can also be used in herbal medicine, mouthwash

and toothpaste (Goyal *et al.*, 2010). It is also often used in the confectionery industry (Belščak-Cvitanović *et al.*, 2015). The use of stevia can be beneficial to diabetics, as it does not affect blood sugar levels and is beneficial to people who want to decrease their calorie intake (Goyal *et al.*, 2010).

2.8.2 Erythritol

Erythritol can also be used as a sugar substitute. It is derived from the fermentation of glucose and sucrose from *Trichosporonoides megachiliensis* and is almost as sweet as sucrose (60-80% relative sweetness) (Aidoo *et al.*, 2013). When sugar is replaced with a sweetener in chocolate, a bulking agent is needed to produce chocolate that is similar to chocolate with sugar (De Pelsmaeker *et al.*, 2017). Erythritol also has bulking properties, but when it is used in products such as chocolate, it can give the perception of a cooling effect or a burning aftertaste (Aidoo *et al.*, 2013). This effect can be eliminated by using water-soluble dietary fibres, which can also be combined with fructo-oligosaccharide and inulin, as it will remove the perception of the cooling effect or burning aftertaste (Brown *et al.*, 2008).

2.9 Consumer affective decision making

A consumer's decision-making process starts when the consumer has an identified need, followed by four other stages resulting in consumer satisfaction or dissatisfaction (Mpinganjira, 2013; Schiffman & Kanuk, 2010). There are five stages in the decision-making process for consumers: need recognition; information search; evaluation of alternatives; purchasing decision; and post-purchase consumption and evaluation (Erasmus, 2013). Taking the five stages into consideration, perspectives on consumers' decision making can be divided into three types of processes, namely the cognitive, habitual and affective processes (Bangsa & Schlegelmilch, 2020; Solomon *et al.*, 2012). The cognitive decision-making process uses a traditional approach where a consumer follows the steps in the decision-making process, which may create a learning process that will influence a similar choice that will be made in future in the event of consumer satisfaction (Bangsa & Schlegelmilch, 2020).

Habitual decision making does not follow elaborate steps in the decision-making process, but instead, is a decision consumers make out of routine or habit, involving little or no conscious effort (Bangsa & Schlegelmilch, 2020). These decisions are repeated frequently, almost without any consideration of alternatives, as consumers trust the product or service due to repeated purchases (Erasmus, 2013).

Affective decision making is the process where consumers make a decision about products and services on their emotional response (Solomon *et al.*, 2012). Emotions widely affect

consumers' decision making, and anticipated emotions may trigger anticipatory feelings at the time of the decision (Buck *et al.*, 2018; Eberhardt *et al.*, 2019). For example, thinking about chocolate can raise a realisation of indulgence, happiness or desire, and these emotions may trigger anticipatory feelings of joy and excitement (Buck *et al.*, 2018). When consumers are confronted with cognitively demanding tasks, they may find it easier to rely more on emotions than on rational thought when making their decisions (Eberhardt *et al.*, 2019).

2.10 Sensory evaluation

Affective decision making includes sensory evaluation (Ferrarini *et al.*, 2010b). Sensory evaluation is known as a set of techniques that accurately measure consumers' response to food and beverages while minimising the bias effect of information about the product and brands on the consumers' perception (Singh-Ackbarali & Maharaj, 2014). This is done through a scientific method that will evoke, measure, analyse and interpret the response to a specific product as perceived through the consumers' five senses of sight, hearing, smell, taste and touch (Lawless, 2013). It is essential that food products meet the sensory expectations of consumers, as this will lead to a positive sensory experience. Therefore, developers of food products and food and beverage companies require information from consumers on their perceived sensory characteristics of food products (Guinard *et al.*, 2001; Ten Kleij & Musters, 2003). Through the use of sensory evaluation, meaningful information about the product can come forward that will help the product developers to match the ideal of consumers or to get closer to setting a benchmark (Brody & Lord, 2007; Lawless, 2013). This will then reduce the risk of product failure in the market (Singh-Ackbarali & Maharaj, 2014) and help companies to make informed business decisions (Stone & Sidel, 2004).

Consumers' sensory response is expected to relate to rational decisions based on food properties (Manzocco *et al.*, 2013). Consequently, sensory evaluation methods started to progressively expand in the areas of food product development and consumer preference, which caused a change in scientific focus. This change came from studying only food products to studying both the food products and the consumers consuming food products (Köster, 1981; McBride, 1990; Meiselman, 1993; Trijjp, 1995), which required the inclusion of consumers in sensory evaluation studies.

It has been shown that emotional factors are linked to a consumer's sensory experience, which might influence their choice for a product (Ferrarini *et al.*, 2010b). Consumers' preference, acceptance and Likert liking are known as a test with untrained panels to test the acceptance of the characteristics of a product to find out whether the product satisfies consumers' needs (Singh-Ackbarali & Maharaj, 2014). Mahato *et al.* (2021) conducted a study with untrained

consumer panels to determine whether the combined use of natural non-nutritive sweeteners (stevia sweetener and monk fruit extract) could be used to partially reduce sugar in chocolate-flavoured milk while still maintaining the consumers' liking and acceptance of the product. The study was successful, as the consumers accepted and liked the product (Mahato *et al.*, 2021). Food products are usually evaluated on all sensory aspects, including appearance, smell, taste and texture (Singh-Ackbarali & Maharaj, 2014). The sensory experience that consumers have with a product is seen as a crucial factor in their choice and acceptance of the product (Tuorila, 2007). Acceptance measures the extent to which a specific product is liked or disliked and whether consumers would purchase and consume this product (Castura, 2018). The results are used as feedback to determine whether the product will be successful on the market. If necessary, a few changes can be made to the product if the consumers did not entirely approve of the product. If the feedback was not mostly positive, the product will not be placed on the shelves, as consumers will likely be unsatisfied when they purchase the product (Singh-Ackbarali & Maharaj, 2014).

As consumers have to experience (taste) a product in sensory evaluation in order to evaluate the sensory properties of the product, the sensory attributes play an essential role in consumers' product evaluation (De Pelsmaeker *et al.*, 2013; Marreiros & Ness, 2009; Piqueras-Fiszman & Jaeger, 2014). The experience consumers have during the sensory evaluation will influence their preference and choice (Juodeikiene *et al.*, 2018). This was proven by Taljaard (2020), who investigated the relationship between the sensory properties of chocolate and the emotional response of consumers and what the impact of various internal consumer behaviour variables in this response was. It was reported that a bitter taste drove emotional response and that a positive mood resulted in a positive emotional response. Chaya *et al.* (2015) support these findings as they reported that sweet and bitter sensory attributes influence emotion categories, scoring high in pleasant emotion categories for high sweetness and low bitterness, and the other way around.

2.11 Conclusion

In order to understand how consumers' taster status influences their emotions when purchasing and consuming sugar-free chocolate, it is important to understand all aspects of taste and consumers' emotional responses. Understanding the impact of taste in consumers' preferences for sugar-free foods products might have significant implications for both marketers and researchers in the food industry. Having knowledge of consumers' emotional response to food products can offer a new perspective that can be used to identify consumers' motivation for behaviour with regard to food choice. As consumers are aware of the disadvantages of excessive sugar intake due to the range of health issues it can cause, the

confectionery markets are adapting to the demands of consumers and have to develop a strategy that can provide customised products that promote healthy eating without compromising the sensory properties of products. To achieve this, it is important to be conscious of the variation in consumers' taste perception.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction

Chocolate is consumed throughout the world. However, presently, the relationship between consumers' emotions and their taster status when they consume sugar-free chocolate is unknown. Therefore, this study seeks to develop an emotional lexicon to describe sugar-free chocolate according to consumers' taster status and their consumption and purchasing behaviour. Potential respondents first received an electronic screening questionnaire via e-mail to determine whether they fitted the inclusion criteria before they were allowed to evaluate two chocolate samples and complete the electronic main questionnaire. In this chapter, the methodology that was applied to collect the data to answer the aim and objectives of the study will be discussed. First, the research design and sampling used for the study will be discussed, followed by a discussion of the data collection and analysis as well as the ethical issues that were addressed.

3.2 Research design

In this study, a quantitative research approach was followed. Quantitative research can be defined as quantity or numerical data providing statistics (Gravetter & Forzano, 2016; Yang, 2014). The research design made use of electronic questionnaires to collect data, as the questionnaire was well formulated, making it easy to collect quantifiable data from respondents (see Walliman, 2011). A non-experimental, descriptive, cross-sectional survey design was chosen for the study, as the researcher only made use of questionnaires to gather information (see Maree & Pietersen, 2016c; Walliman, 2011). A descriptive research approach was used to describe how various aspects would affect one another (see Botma *et al.*, 2016), such as how sugar-free chocolate played a role in consumers' emotions. A cross-sectional survey is known as research conducted to examine information at a certain point in time (Neuman, 2014). This design founded the occurrence of a situation, phenomenon, attitude, issue or problem by using a cross-section of the population (Kumar, 2011). The cross-sectional element was an essential factor of the research, as it determined the influence of the respondents' demographic characteristics on their taster status at the time of the study.

3.3 Study location

The study population includes South African adult consumers who live in the Dr Kenneth Kaunda District (Potchefstroom), situated in the North-West Province. Over four million people live in North-West Province (StatsSA, 2019b), with approximately 742 821 people living in the

Dr Kenneth Kaunda District (StatsSA, 2016). Looking at the estimated migration patterns for 2016 to 2021, North-West has had immigrations from all the other provinces of South Africa, with the highest being from Gauteng (111 893), Eastern Cape (38 019) and Limpopo (33 848), with an estimated total of 80 005 people immigrating from outside of South Africa (StatsSA, 2019b).

The NWU is the third-largest university in South Africa, with two of its campuses situated in North-West, one being located in Potchefstroom (NWU, 2019). The NWU enrolled 62 558 students in 2017, with a total of 41 765 on-campus students (NWU, 2019). This results in a wide variety of consumers with diverse socio-economic characteristics, such as gender, age, income and education level, residing in Potchefstroom. This factor ensured that the study included a wide variety of respondents, as the NWU is a major attraction point for students from other provinces to complete their studies at the Potchefstroom Campus. In addition, as Potchefstroom has many surrounding towns, respondents who visited Potchefstroom from other towns, such as Carletonville, Fochville, Orkney, Stilfontein, Klerksdorp, Parys and Ventersdorp, could also participate in the study. Potchefstroom was, for this reason, seen as a suitable study location.

The online questionnaire was completed at a time and place that were most convenient to the respondents. Therefore, Potchefstroom served only as a location where the respondents collected their chocolate samples (which were needed to complete the online questionnaire) from a central location (see Section 3.7.2). The population of Potchefstroom consists of 50% female and male residents, respectively (StatsSA, 2019a). The municipality of Potchefstroom has a total of 179 604 people, of which 72,09% are Africans, 20,66% are white, 6,48% are coloured and 0,75% are Indian or Asian (JB Marks Local Municipality, 2018). For this study, the demographic profile of the respondents included male and female consumers above the age of 18 years who were in Potchefstroom at the time of the collection of the sample bags.

3.4 Sampling

3.4.1 Inclusion criteria

The inclusion criteria ensured that consumers of all ages and ethnic groups had an equal chance to participate in the study (see Babbie, 2013). For this study, the respondents:

- had to be 18 years or older to give informed consent to participate in the study;
- had to be computer-literate and understand English, as the questionnaire was electronic and in English (see Section 3.4.2.1);

- should have consumed chocolate at least once in the past year in order to have a familiarity with chocolate to be considered as a chocolate consumer and
- had to enjoy eating chocolate, as they had to eat chocolate in the study and a dislike of chocolate would have skewed the results of the study.

3.4.2 Exclusion criteria

Any potential respondents who did not fulfil the proposed criteria were excluded from taking part in the study (see Larkin & Martin, 2016). Below are the specific criteria that were used to exclude respondents:

- should not have any specific dietary requirements (e.g. banting, vegan or low glycaemic index);
- should not be on any chronic medication that might have the potential to influence the respondents' taste by decreasing function or phantom tastes (see Doty *et al*., 2008);
- should not be suffering from any oral diseases or gum diseases, as these may influence chemosensory functioning (see Ship, 1999);
- should not be pregnant or suspect that they might be pregnant, as this was a tasting study and tasting the chocolate might cause harm to the fetus (see Blehar *et al*., 2013); as well as the following criteria's explained below.

3.4.2.1 Lack of education in the English language

As the questionnaire was in English and self-administrated, the potential respondents needed to understand and be able to read English (see Babbie, 2014; Kempen *et al.*, 2012). Any respondent who was illiterate in English was excluded, as this is the primary language in which information about food products is given (Koen, Wentzel-Viljoen, Nel *et al.*, 2018; Van der Merwe *et al.*, 2014), as on food labels. English is generally used for communication on social media platforms (Gravetter & Forzano, 2016; Hine, 2008), and as the study was advertised on social media, the respondents needed to read the advertisement to receive information about the study. Consequently, respondents who did not meet these criteria were excluded from the study.

3.4.2.2 Computer literacy

Since this study made use of electronic advertising platforms (Facebook® and Instagram), the respondents should have had basic knowledge of smartphone or computer technology to access the social media platforms to view the advertisement. They also had to know how to send an e-mail, as this was the primary form of communication between the research assistant

(contact person) and the prospective respondents. The tool that was used to gather data was an electronic questionnaire filled out on a smartphone or computer. As a result, the prospective respondents needed to know how to open a link to access the electronic questionnaire. All of the potential respondents should thus have had a basic level of computer literacy. Consequently, prospective respondents who were computer illiterate were excluded from the study (see Buhrau & Ozturk, 2018; Kumar, 2011).

3.4.2.3 Food allergies or sensitivity and intolerances

The selection of food products was significantly influenced by consumers who had food allergies or sensitivity to specific food products as well as food intolerances (see Gravel *et al.*, 2012; O'Brien *et al.*, 2015; Rolfes *et al.*, 2015). Keeping this in mind, potential respondents who showed any allergy, sensitivity or intolerance to any of the ingredients (Addendum O) in the chocolate were excluded from the study.

3.4.2.4 Advanced knowledge of food products and aspects of taster status

To eliminate potential bias that is associated with in-depth knowledge and education related to chocolate and consumer taster status, consumer or food scientists, nutritionists and dietitians did not qualify to participate in the study (see Van der Merwe *et al.*, 2012). These specialists have in-depth knowledge within the field of food products that could have influenced their perception of and decision making about chocolate and taste (Botelho *et al.*, 2018).

3.4.3 Sampling technique

Sampling was done by recruiting individuals who represented a larger part of the population from whom the researcher could obtain the desired information (see Yang, 2014). A non-probability convenience sampling method with inclusion and exclusion criteria was used for the study. Convenience sampling is known as the selection of population elements based on being easily and conveniently available (Maree & Pietersen, 2016b). Respondents who fitted the inclusion criteria could take part in the study. As the study took place in North-West, Potchefstroom, respondents who lived in this province at the time of data collection were recruited to participate in the study. The reason for this was that the respondents would have had to travel to a central location in Potchefstroom to collect two chocolate slabs to evaluate and taste at home. Therefore, the probability that only Potchefstroom residents would travel to this central location to collect their chocolate slabs and participate in the study was high.

However, it might have been that their primary residence was located in other parts of South Africa, although their temporary residence was in Potchefstroom due to their affiliation with the NWU (see Section 3.3). Non-probability sampling was employed as the researcher made use of an unbiased method to select the respondents (see Gravetter & Forzano, 2016) by using the inclusion and exclusion criteria that are listed in Sections 3.4.1 and 3.4.2.

3.4.4 Sampling frame

The researcher made use of various avenues to recruit a heterogeneous group of respondents that met the specified criteria (see Herman & Polivy, 2010; Van der Merwe *et al.*, 2012). This being the case, a targeted advertisement (Addendum B) was posted on Instagram and several Facebook® pages of the NWU (see Ares *et al.*, 2018). This medium was chosen as it was applicable to the study, given that the internet and social media platforms are widely accessible and a significant number of consumers use these every day (see Ares *et al.*, 2018; Matthews & Kostelis, 2011).

3.4.5 Sample size

A reasonable sample size is required for a study to be able to collect accurate data, estimate the characteristics of the population and provide statistically significant results (Maree & Pietersen, 2016b). The SCS of the NWU recommended a sample size of 180 respondents, with the recommendation based on enough respondents to perform exploratory factor analysis (EFA) (see Mai & Hoffmann, 2012).

A power calculation was performed using G*power version 3.1.9.2. The power calculation was performed considering a χ^2 goodness-of-fit test for a 3×2 contingency table. Cramer's υ was regarded as the standardised effect size in this calculation. According to the calculation, a sample size of 183 was sufficient to detect medium effect sizes ($\upsilon > 0{,}23$) with a type II error below 20% (power $\geq$ 80%) when using Pearson's χ^2 test of independence to determine associations between taster status and an emotional lexicon. Consequently, the researcher aimed to recruit 180 respondents, but only 158 respondents filled out the main questionnaire. Out of the 158 respondents, 153 questionnaires were completed in full and were usable to perform statistical analysis (see Chapter 4). Figure 3-1 is an illustration of the simulation of the power calculation in relation to the sample size.

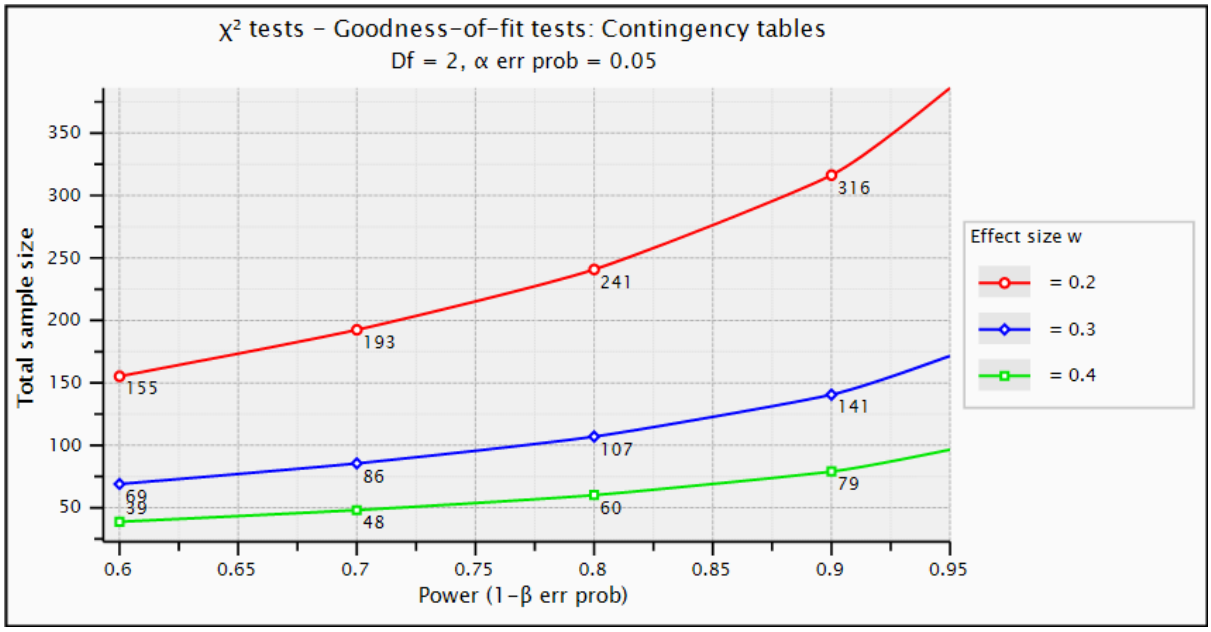

Figure 3-1: Power calculation in relation to the sample size

3.5 Recruitment of respondents

The respondents were recruited via social media platforms such as Facebook® and Instagram, where an electronic poster (see Addendum B) was placed in January 2021. The advertisements provided potential respondents with an overview of the study and included the contact details of the researcher. Individuals who were interested could follow the link on the advertisement that redirected them to a web-based portal that included the electronic informed consent form (Addendum A) and screening questionnaire (Addendum C). Refer to Section 3.6 for the process of obtaining informed consent and Section 3.7.1.4 for a discussion of the screening questionnaire. After the completion of the screening questionnaire (Addendum C), the respondents who met the inclusion criteria (Section 3.4.1) were contacted by e-mail to provide them with more details about the study, such as the date, time and location to collect the sample bag (Addendum D).

One week before the study commenced, the respondents received a reminder of the study via e-mail, including the electronic link to the consent form to familiarise themselves with the study (Addendum E). The day before the data collection commenced, the respondents received an e-mail containing a link of the location where the sample bags should be collected (Addendum F). They were also reminded to wear a face mask (to adhere to the Covid-19 regulations) when they entered the premises to collect the sample bag.

On the day the sample bags were collected, the research assistant was at the central location to give the respondents a short briefing of the study and to remind them of the chocolate

ingredients and not to participate if they were allergic or sensitive to any of the ingredients. The research assistant also reminded them of the contact details of the research assistant should they have any problems. The researcher was close to the central location should the respondents have had any questions that the research assistant could not answer.

3.6 Process of obtaining informed consent

The respondents were provided with a written, electronic informed consent form before they started with a screening questionnaire and the main questionnaire. The informed consent form contained all the procedures, including their contribution towards the research, every potential risk and the expected time for completing the questionnaire (see Chiumento *et al.*, 2020; Walliman, 2011). This ensured that the respondents made an informed, rational and voluntary decision to participate in the study (see Salkind, 2014; Wood & Shukla, 2016). As the primary language on food packaging and of marketing-related information is English (Koen, Wentzel-Viljoen, Nel *et al.*, 2018; Van der Merwe *et al.*, 2014), along with the language mainly used on social media platforms (Gravetter & Forzano, 2016; Hine, 2008), the language used in the consent form (Addendum A) was English. The respondents should have read and accepted the informed consent form (in an electronic and written format) on the survey program QuestionPro© (www.questionpro.com) before they could have completed the screening questionnaire and the main questionnaire.

The informed consent form ensured that the prospective respondents could carefully review the information provided to them and consider possible participation (see Fernandes *et al.*, 2015; Janse van Rensburg, 2014). It gave the respondents detailed information on what the proposed study entailed and provided them with a summary of the purpose of the research (see Heiman & Lowengart, 2014; Kumar, 2011; Soldavini *et al.*, 2012). Furthermore, before the respondents could taste the chocolate samples and get access to the main electronic questionnaire, they had to agree to the terms of voluntary participation (see Babbie, 2013; Creswell, 2014; Fernandes *et al.*, 2015; Strydom, 2005).

Apart from the e-mail addresses and names of the respondents, no other personal information was required from the respondents, and they were not penalised if they wanted to withdraw from the study at any given time (see Gravetter & Forzano, 2016; Salkind, 2014). The respondents were provided with the research assistant's contact details in the advertisement and the informed consent form. They were encouraged to ask questions if they had any uncertainties regarding the study (see Creswell, 2014; Gravetter & Forzano, 2016). The respondents who, for any reason, did not want to continue with the study could withdraw from

the study. No respondent withdrew from the study, although five questionnaires were incomplete and, consequently, not used for further data analysis.

3.7 Data collection

Measurement connects the data to complex concepts, making it an important factor in quantitative, descriptive research (Gravetter & Forzano, 2016; Neuman, 2014), such as consumers' behaviour with regard to sugar-free chocolate. As this study aimed to develop and to describe sugar-free chocolate according to consumers' taster status and their consumption and purchasing behaviour, a cross-sectional online questionnaire (Addenda J-N) was considered appropriate. Data were collected in two stages: Stage 1 – screening questionnaire; and Stage 2 – collection of the chocolate samples and completing the main questionnaire. Figure 3-2 provides an outline of the preparation of the research materials, the stages in the data collection and, lastly, the data analysis.

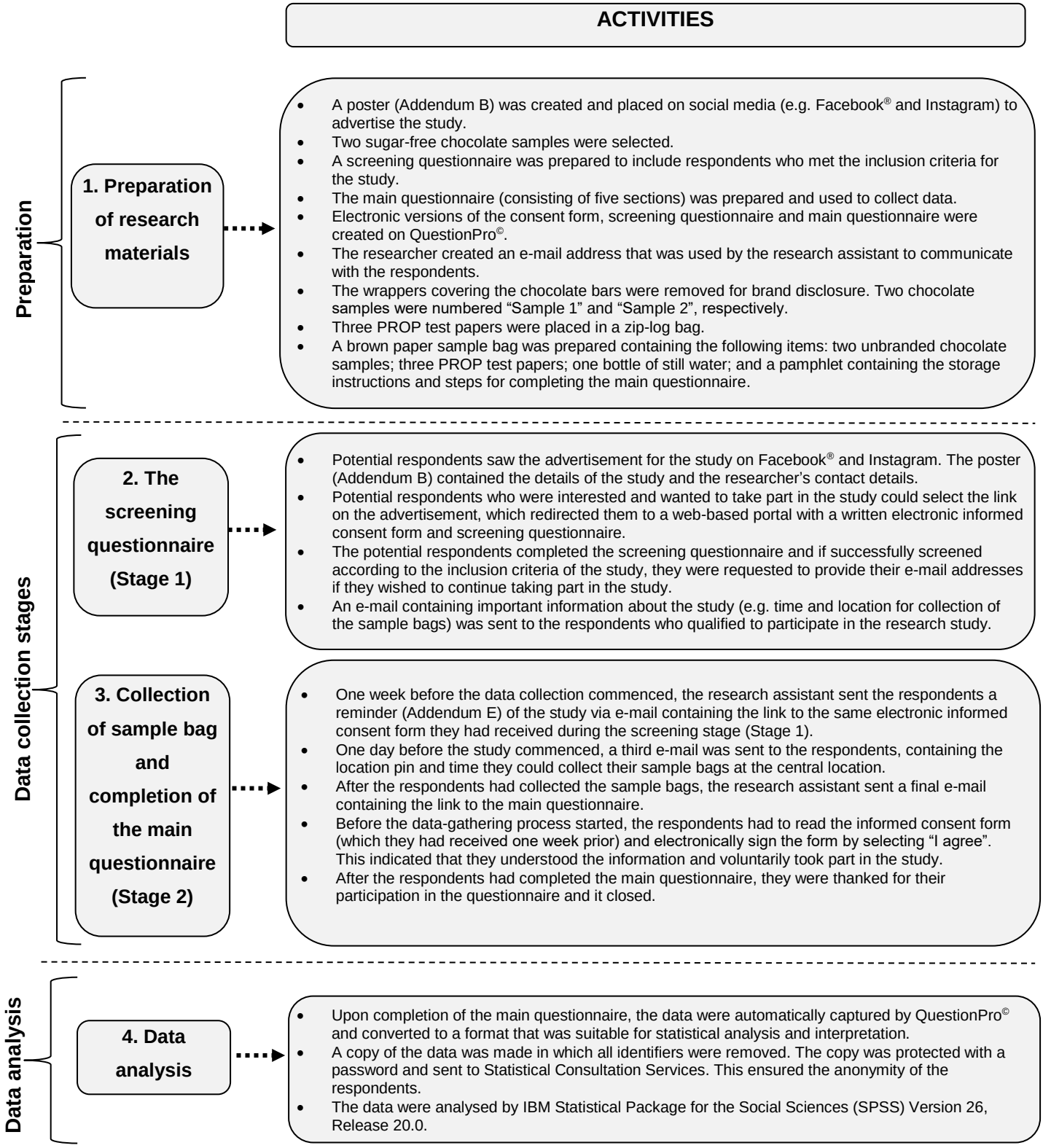

Figure 3-2: Outline of data collection and analysis

3.7.1 Preparation of research materials

All research materials were handled and prepared hygienically. Before preparing the sample bags, the researcher sanitised her hands with an alcohol-based sanitiser. A face mask, laboratory coat, disposable hairnet and food preparation hand gloves were worn at all times during the preparation.

3.7.1.1 Preparation and presentation of n-propylthiouracil test paper

For the taster status test, n-propylthiouracil (PROP) test paper strips (see Figure 3-3) were used to determine the respondents' ability to taste PROP. The PROP test papers, packed in vials containing 100 strips, were purchased from Vacutec (Pty) Ltd. Each PROP test paper strip contained 3 to 5 mg PROP.

Figure 3-3: PROP test papers strips

The ability to taste PROP indicates a respondent's sensitivity towards the bitter taste, resulting in the categorisation of three different taster groups: supertaster, medium taster and non-taster (Zhao *et al*., 2003). Two common haplotypes are identified by polymorphisms in the TAS2R38 gene (bitter taste receptor): the functional taster allele of the TAS2R38 that encodes proline, and valine alanine; and the non-functional non-taster allele of the receptor that encodes isoleucine, alanine and valine respectively (Cantone *et al.*, 2018). Individuals who are homozygous or heterozygous for the functional allele proline, alanine and valine perceive PROP as bitter and are classified as ST (Cantone *et al.*, 2018). For this study, three PROP

paper strips were placed in a plastic zip-lock bag (see Figure 3-4) and stored at room temperature (20°C).

Figure 3-4: Three PROP test papers strips in zip-log bag

3.7.1.2 Preparation and presentation of chocolate samples

For this study, sugar-free chocolate bars were purchased from a local food retail company. These chocolate bars were used due to a lack of a variety of sugar-free chocolate bars in South Africa, and these bars being established products in the South African market. This chocolate is classified as sugar-free, as it is sweetened with steviol glycosides, a non-nutritive sweetener obtained from the stevia plant.

The number of chocolate samples was determined by the type of product, the total number of questions in the questionnaire and the time given to complete the test (see Hein *et al.*, 2008). It is recommended that the number of samples a researcher should use is two, to ensure that the respondents do not experience fatigue (King & Meiselman, 2010). A study has found that the emotional ratings and likings decrease for samples presented at the end; this effect can be minimised by using a total of only two samples (Gutjar, De Graaf *et al.*, 2015). Thus, two sugar-free chocolate samples were used in the present study. The first sample was a 40 g bar of sugar-free milk chocolate and the second sample a 40 g bar of sugar-free dark chocolate. Both samples have no added sugar and are made with sustainable cocoa and sweeteners. See Table 3-1 for the ingredients and nutritional value of the chocolate samples.

Table 3-1: Chocolate samples – ingredients and nutritional information

	Milk (Sample 1)[1]		Dark (Sample 2)[2]	
Description	**Per 100 g**	**Per g serving**	**Per 100 g**	**Per g serving**
Energy (kJ)	2024	810	1851	740
Protein (g)	7.9	3.2	5.8	2.3
Carbohydrate (g)	34	14	18	7
Total sugar (g)	20.9	8.4	3.0	1.2
Total fat (g)	36.2	14.5	36.3	14.5
Saturated fat (g)	22.9	9.2	22.8	9.1
Monounsaturated fat (g)	12.1	4.8	12.3	4.9
Dietary fibre (g)	17.0	6.8	34.5	13.8
Sodium (mg)	240	96	8	3

Notes: Ingredients: 1 = cocoa butter, full milk powder, fibres (dextrin, inulin, oligofructose), cocoa mass, whey powder, sweeteners (erythritol, steviol glycosides), emulsifier: soya lecithin, vanilla. milk chocolate contains cocoa solids 36% minimum and milk solids 30% minimum; 2 = cocoa mass, fibres (dextrin, inulin, oligofructose), sweeteners (erythritol, steviol glycosides), cocoa butter, roasted cocoa beans (7%), emulsifier: soya lecithin, vanilla. dark chocolate contains cocoa solids 80% minimum.

A sample can be presented to respondents in various ways, such as branded or unbranded, with or without the packaging and tasted or not tasted. Nevertheless, a study in which the EsSense profile™ (King & Meiselman, 2010) was used to measure consumers' overall acceptability of and emotions with regard to products yielded different results on emotional profiles in a blind tasting with packaged and unpackaged products in taste conditions (Gutjar *et al.*, 2015a). A sample can, to some extent, provoke different emotions from respondents depending on a blind test (packaged and unpackaged) (Gutjar *et al.*, 2015a). For the preparation of the samples for the present study, all of the chocolate slabs were unbranded. The wrappers containing the brand and additional information on the label were removed to ensure blind tasting (see Figure 3-5). All of the samples were stored at room temperature (20°C).

Figure 3-5: Unbranded chocolate sample

Each respondent received two chocolate bars – one sugar-free milk chocolate (Sample 1) and one sugar-free dark chocolate (Sample 2). Each 40 g sample contained five blocks of 3 cm x 1,5 cm x 1,3 cm (see Figure 3-6).

Figure 3-6: Chocolate Samples 1 and 2

3.7.1.3 Preparation of sample bags

The researcher prepared 180 brown paper sample bags, each consisting of:

- two unbranded chocolate samples clearly marked as Sample 1 and Sample 2;
- three PROP test paper strips in a zip-lock bag;
- one bottle of still water (250 ml) used for palate cleansing (see Lawless & Heymann, 2010; Rocha *et al.*, 2017; Schouteten *et al.*, 2015); and

- a pamphlet containing the storage instructions (Addendum G) and steps to complete the main questionnaire (Addendum H).

3.7.1.4 Screening questionnaire (Addendum C)

The screening questionnaire did not form part of the main questionnaire, as the screening questionnaire had been completed beforehand to ensure that all of the respondents who completed the main questionnaire met the inclusion criteria. This forms part of the data collection process as outlined in Section 3.4.1.

In the screening questionnaire, the respondents had to answer 11 questions truthfully to determine whether they qualified to participate in the study. They simply had to choose an option displayed for each question. If they chose the option that met the inclusion criteria, they were able to continue to the next question. If they chose an option that fell outside the inclusion criteria for any question, the survey automatically closed. A screen then appeared, thanking them for their interest in the study and informing them that, unfortunately, they had not met the necessary requirements. Those respondents who had met the inclusion criteria were requested, at the end of the screening questionnaire, to enter their e-mail addresses if they wanted to participate in the study. It was clearly stated to them that their e-mail addresses would only be used to communicate with them for the purpose of the study and to receive more information regarding the study. Respondents who preferred not to enter their e-mail addresses were automatically discontinued from the study.

3.7.1.5 Main questionnaire

3.7.1.5.1 Development of data collection instrument

The main questionnaire was developed and made available to the respondents through the survey program QuestionPro© (www.questionpro.com). The questionnaire was only available in English, as English is the official spoken language by most South African consumers and is the dominant language in which research is conducted (Alexander, 2007; Casale & Posel, 2011).

The order in which the questionnaire was presented to the respondents had been carefully considered, as one measure might have an impact on the next measure (see King *et al.*, 2010). It is recommended that questions measuring overall acceptability should be placed before those measuring emotions (King *et al.*, 2010). Studies found that alphabetical listings could facilitate response and that the fatigue of respondents was lower (De Pelsmaeker *et al.*,

2013; Jaeger, Chheang *et al.*, 2013; King & Meiselman, 2010; Reinbach *et al.*, 2014); therefore, this study made use of alphabetical listings of emotional terms.

Emotions can be a useful source of product differentiation (Giacalone, 2018). Therefore, when consumers' emotions towards a specific product are tested, different emotional terms have to be included in the questionnaire with the purpose of not excluding an emotion that may be relevant to a consumer (Spinelli, 2017). However, it has also been found that one should not include emotional terms that are not applicable to the product (Jaeger, Cardello *et al.*, 2013). One should make an accurate selection of emotional terms to include all the relevant terms so that the different consumers can make accurate choices (Spinelli, 2017). A crucial part of developing an emotional lexicon is choosing the emotions that form part of the list, as the emotions should relate to the product and the respondents should understand what is meant by these emotions (Jaeger, Cardello *et al.*, 2013; Spinelli *et al.*, 2014). With an emotional lexicon, one will be able to understand consumers' choices (Gunaratne *et al.*, 2019).

In choosing a technique to measure emotions that are caused by food products, there are some factors that one should consider, namely the potential of the method to capture differences, the culture and the length of the questionnaire (Mora *et al.*, 2020). These factors are briefly discussed next.

- In consideration of **the potential of the method to capture differences**, one can make use of general emotional lexicons to measure the emotional response of respondents to any food category (King & Meiselman, 2010; Spinelli *et al.*, 2014; Thomson & Crocker, 2013). It is strongly recommended that one should develop a lexicon that is specific to one food product, since it will be more suited to capturing subtle differences in respondents' feelings among the samples within a particular product category (Ng *et al.*, 2013; Silva *et al.*, 2016; Van Zyl, 2016), in this case, sugar-free chocolate.
- **Culture** can affect meaning of emotional terms, dimension and the use, as well as the respondents' familiarity with the product (Van Zyl & Meiselman, 2015, 2016). Emotional lexicons can only be used for the culture of the consumers they have been designed for, as the emotional terms and the meaning thereof can influence the emotional connection that respondents have with the product (Van Zyl, 2016; Van Zyl & Meiselman, 2015). In this case, the lexicon of emotion was developed for the food industry to develop sugar-free chocolate that stimulates or evokes specific emotions.
- **The length of the questionnaire** will have an impact on how much time and effort respondents need to accomplish the task of expressing their feelings evoked by a product (Cardello *et al.*, 2016; Van Zyl, 2016). As a result, this study made use of fewer emotional terms that were listed in alphabetic order to keep the questionnaire short.

Furthermore, the respondents were requested only to choose those terms they felt were relevant.

Considering these three factors, an emotional lexicon was created with emotional terms that evoked emotions for sugar-free chocolate in a short and easy questionnaire that was relevant to English-proficient consumers of chocolate (see Mora *et al.*, 2020).

The main questionnaire consisted of five sections, starting with the PROP taster status test in Section A (Addendum J). In Section B, the respondents were asked how likely they consumed food that is known for its bitterness (Addendum K). In Sections C (Addendum L) and D (Addendum M), the respondents tasted the chocolate samples and answered the questions. The last section captured the respondents' demographic information (Section E, Addendum N). See Section 3.7.1.5.2 to 3.7.1.5.6. Also, see Figure 3-7 for the outline of the main questionnaire.

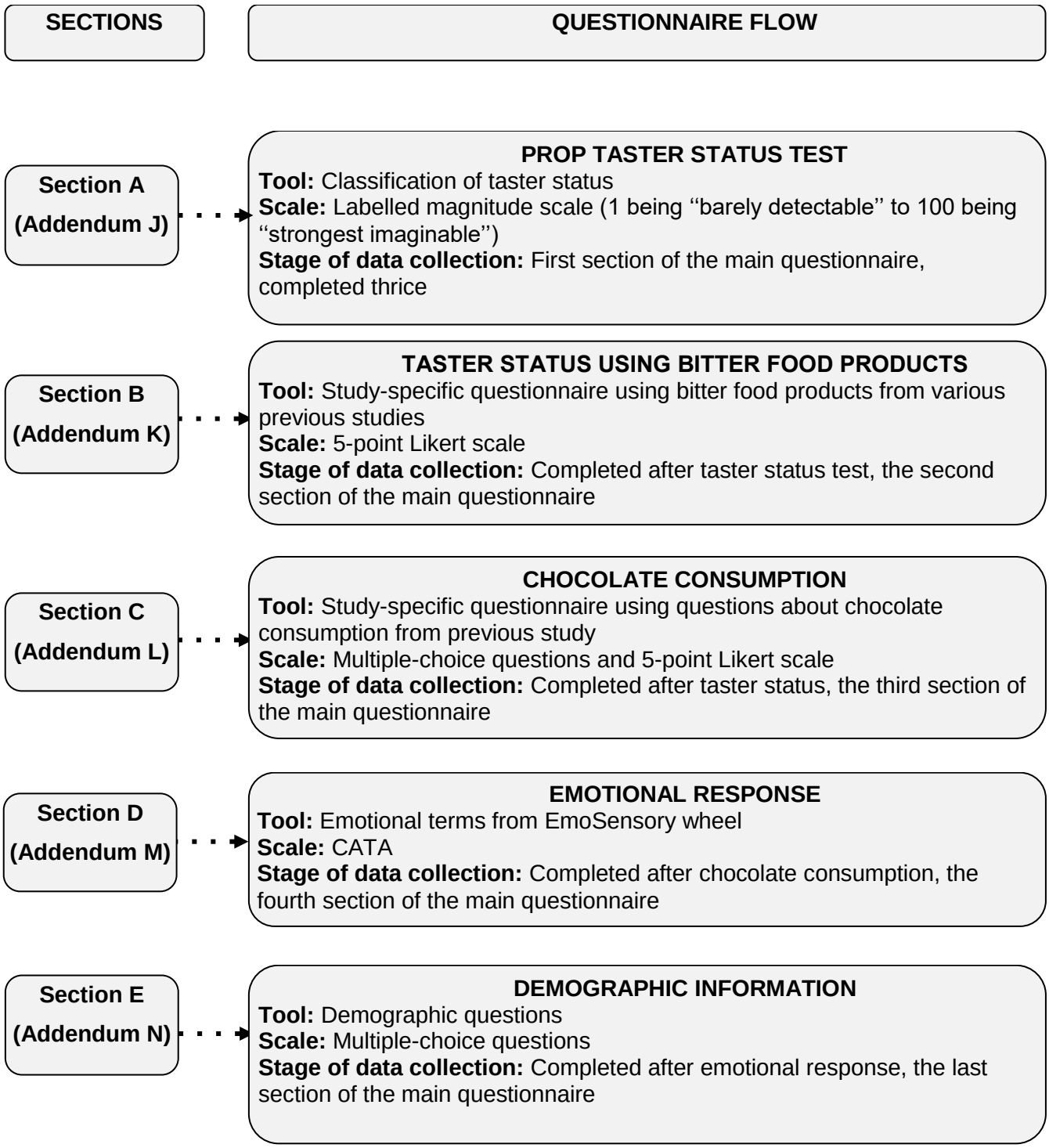

Figure 3-7: Outline of main questionnaire

3.7.1.5.2 Main questionnaire Section A: Taster status test (Addendum J)

In the first section of the main questionnaire, the respondents were requested to follow the instructions on how to test their taster status. Before tasting, the respondents first had to rinse their mouths with the supplied still water. They were requested to place the first PROP paper strip on the tip of their tongue for 30 seconds or until the paper disk was wet with saliva and then remove it from their mouths (see Yang *et al.,* 2019). After tasting the paper strip, the respondents were requested to rate their perception of the stimulus on the LMS, which ranged from 1 being "barely detectable" to 100 being "strongest imaginable". The respondents received an explanation on how to use the LMS as described by the method of Green *et al.* (1993) (Addendum J). They were also requested to take a three-minute break and clean their palate using the supplied water and to repeat the process two more times. Hence, the process was performed in triplicate to verify and compare the relative difference between the ratings. The respondents were then classified according to the level of bitterness they could taste. The cut-off criteria for the classification of the tasting groups were as follows: NT were between 0 and 15,5; MT between 15,5 and 51; and ST were above 51 (see Sollai *et al.,* 2017; Tepper *et al*., 2001; Zhao *et al.,* 2003).

This section, together with Section B of the main questionnaire (as discussed in Section 3.7.1.5.3), assisted in identifying the respondents' taster status. This section of the main questionnaire addressed the first research objective, which was to determine the consumers' taste experience, consumption and purchasing behaviour of sugar-free chocolate, as well as the third objective, which was to determine the association between emotional lexicons and consumers' taster status.

3.7.1.5.3 Main questionnaire Section B: Taster status food products (Addendum K)

In this section, the respondents made use of a five-point Likert scale (where 1 equals an extreme dislike and 5 equals extremely likeable), rating food products that are known for their bitterness. This tested the respondents' TAS2R gene based on how likely they were to eat different food products. The following food products were included in the questionnaire: broccoli, brussels sprouts, cabbage, asparagus, spinach, grapefruit or pomelo, tonic water, black coffee (without sugar), dark chocolate, grapefruit juice, green tea (without sugar), legumes (e.g. black-eyed peas, chickpeas and beans), beer and nuts. As stated in Section 2.3, various studies have been conducted using these food products to test consumers' taster status. According to the respondents' rating of the food products, they were categorised as follows: 1 (an extreme dislike) and 2 (dislike very much) were placed in the supertaster group;

3 (neither like nor dislike) were placed in the medium taster group; and 4 (like very much) and 5 (like extremely) were placed in the non-taster group.

First, the respondents were asked to rate the food products that were known for their bitterness before they tasted the chocolate samples. This was done in order to prevent skewed data by ensuring that the respondents did not feel more positive about the food products after they had tasted the chocolate samples. Therefore, the testing of the chocolate samples (Addenda L and M) happened after the taster status sections (Addenda J and K) had been completed. This section, together with the testing of the PROP paper strips (as discussed in Section 3.7.1.5.2), answered the first research objective of the study, which was to determine the consumers' taste experience, consumption and purchasing behaviour of sugar-free chocolate, as well as the third objective, which was to determine the association between emotional lexicons and consumers' taster status.

3.7.1.5.4 Main questionnaire Section C: Chocolate consumption (Addendum L)

Basic questions on chocolate consumption were posed in the form of multi-choice questions, using the questions from Gunaratne *et al.* (2019) without making any changes or adjustments. This section gave information on the frequency of and reasons for chocolate consumption and what elements consumers used when they purchased chocolate. It consisted of three questions where the respondents were given an open-ended option to type any reason if a suitable option was not available for them to select.

There is a need to understand what motivates consumers' preferences, and the best way to understand the motivation that consumers have for their preferences is through consumer data collection (Risvik *et al.*, 1997; Valentin *et al.*, 2012). Sensory preference testing was done for this study on a 5-point Likert scale measuring the respondents' acceptance of taste and aftertaste as well as their purchase intention for the sugar-free chocolate that was used in the sensory evaluation to determine the emotions of consumers with different taster statuses. The results from the sensory preference test with the developed emotional lexicon can be used by food product developers for product improvement and marketing to consumers with different taster statuses. This section addressed the first research objective, which was to determine the consumers' taste experience, consumption and purchasing behaviour of sugar-free chocolate.

3.7.1.5.5 Main questionnaire Section D: Emotional response using the EmoSensory wheel and the CATA method (Addendum M)

This study implemented the EmoSensory wheel consisting of 17 emotional terms (Schouteten *et al.,* 2015). The EmoSensory emotional terms classification included the following:

- Eight positive terms: glad, enthusiastic, happy, good, pleasant, contented, desire and satisfied.
- Eight negative terms: discontented, dissatisfied, disappointed, disgust, nervous, guilty, sad and unpleasant surprise.
- One unclassified term: calm.

The respondents used these emotional terms with CATA (see Section 2.4.3) to indicate what they were feeling when they tested the chocolate samples. In addition, there was an open-ended question where they could indicate any emotional terms that they felt had not been included on the list. This section answered the second research objective, which was to determine the emotional lexicon for sugar-free chocolate for consumers with different taster statuses, as well as the third objective, which was to determine the association between emotional lexicons and consumers' taster status.

3.7.1.5.6 Main questionnaire Section E: Demographic information (Addendum N)

The items placed at the beginning of a questionnaire can influence respondents' willingness to respond in a questionnaire; therefore, the questions about demographic characteristics were placed in the final section of the main questionnaire. This placement ensured that the respondents felt more at ease while they were answering the questionnaire (see Krosnick & Presser, 2009). Various demographic aspects related to the study were asked. No demographic variable that was not relevant to the emotional response of the study was asked. This section was included to enable the researcher to analyse the emotional response within the South African context. Therefore, this study collected information on the respondents' gender, age and the origin of their geographic location. This section addressed the fourth objective, which was to describe the demographic characteristics of consumers.

3.7.2 Data collection

The respondents were able to collect the chocolate samples for one week from Tuesday, 19 January 2021 to Friday, 22 January 2021 (9:00 to 16:00) and Saturday, 23 January 2021 (9:00 to 13:00) at the central location. As there was only limited space available in the study, the first 180 consumers who met the inclusion requirements were allowed to participate. The

central location was Black Orchid Boutique venue, 91 A Dr James Moroka Street, Potchefstroom.

This central location was chosen for the following reasons:

- The venue is a fairly central point in Potchefstroom, with many other businesses around it, which made it easily accessible to the respondents. Therefore, working respondents who wanted to take part in the study could easily collect the sample bag during their lunch break.
- It is a well-known venue in Potchefstroom and has a relaxing atmosphere. Therefore, it ensured that the respondents felt comfortable when they collected the sample bags.
- It was equipped with the necessary facilities, such as the restaurant's kitchen to receive drinks, easy access to restrooms and sufficient space to collect the sample bags.
- The venue was available to the researcher at no extra cost.
- The venue followed strict Covid-19 safety precautions.

3.7.3 Completion of the research questionnaire

3.7.3.1 Safety precautions

At the time of data gathering, South Africa entered lockdown level 3 due to the Covid-19 pandemic (WHO, 2021). To ensure the safety of the respondents, the necessary safety precautions were in place at the central venue. All of the respondents had to wear a mask before they could enter the venue. Hand sanitisers were available at the collection table for them to sanitise their hands before they received their sample bags. The sample bags were collected in a well-ventilated room, and social distancing was maintained at all times. As the study made use of a central location for the collection of the sample bags, the respondents entered the venue at their own risk. There was a fire extinguisher on the premises in case of fire, and a first aid kit was available on the premises in case of any minor injuries. Any injury would have been reported to the occupational health and safety officer; however, there were no injuries or accidents.

3.7.3.2 Consumer panels

There is a need to directly include consumers in consumer-based methodologies, as they can provide accurate information on the sensory properties of products and have been proven to be similar to trained assessors in many situations (Ares *et al.*, 2011; Dooley *et al.*, 2010; Husson *et al.*, 2001; Moussaoui & Varela, 2010; Valentin *et al.*, 2012; Varela & Ares, 2012). Consequently, more consumers are used in sensory-profiling research with food products (Meiselman, 2013; Moussaoui & Varela, 2010; Varela & Ares, 2012), as the best way to

understand consumers' preferences is through collecting consumer data (Risvik *et al.*, 1997). New tools, such as CATA, have been developed as complementary tools in the sensory and consumer science field to be used by consumers to give product descriptions and feedback. Sometimes these tools may even use their own vocabulary (Moussaoui & Varela, 2010).

For this study, consumer panels were used to specify their emotional response to sugar-free chocolate (see Chaya *et al.*, 2015). A verbal self-reported measure was used, as the respondents evaluated their emotions on a list of words by checking all the emotions that applied to the main electronic questionnaire. These words were then used to develop an emotional lexicon for sugar-free chocolate (see Chaya *et al.*, 2015). An electronic questionnaire was used to collect data with the use of a computer-assisted self-completion method. In measuring emotional response, consumers often make use of self-reported methods, as such methods have the benefit of being short processes to gather information and being low in cost (Dorado *et al.*, 2016). There are two categories in self-reported measurements, known as visual or verbal techniques (Dorado *et al.*, 2016). For this study, verbal self-reported measures were used (see Section 2.4.1). As a token of appreciation, the respondents received a complimentary cup of coffee or tea at the central location when they collected the sample bag.

The respondents were requested to complete the main questionnaire at a time and place that best suited them, although it was recommended that they completed the questionnaire at a place where they usually would consume chocolate so as to mimic a "natural" setting. It was noted that one should not get caught up in the distinctiveness of the location where data are collected, as it could imply that one is busy testing the effects in the location rather than testing theories that should apply to multiple locations (Highhouse, 2009).

The time of day has been found not to be a crucial variable when testing the food related emotions (King *et al.*, 2010). It has also been noted that chocolate, which falls in the snack category, is eaten all day and not at a specific mealtime (see King *et al.*, 2010). Consequently, the respondents were requested to complete the main questionnaire at a time they usually would consume chocolate to mimic the time of actual consumption. The respondents were, however, asked to complete the main questionnaire in one sitting. Once the sample bag had been collected, the respondents received the electronic link to the main questionnaire per e-mail within one hour. The main questionnaire was open for 72 hours after having collected the sample bag, giving the respondents enough time to complete the questionnaire at a time that was convenient to them. As the sample bags were collected from Tuesday to Saturday, the testing day was different for each respondent. All the data were, therefore, collected by the following Tuesday.

3.8 Data analysis

Descriptive analysis is known as organising the data and summarising the characteristics found in the questionnaire to be able to describe the data in a meaningful way (Loeb *et al.*, 2017; Yang, 2014). Descriptive analysis was determined for all variables, including means, frequencies and percentages, with the help of the SCS of the NWU. These services were responsible for data analysis and assisted in the interpretation of the data. For analysing the data, SPSS Version 26, Release 20.0 (SPSS) was used. The data needed to be analysed to reduce the data to a form in which the researcher was able to interpret the data to make conclusions, as it is essential to interpret the numerical data collected by finding an understanding and explanation of the information (De Vos *et al.*, 2011).

Categorical variables were summarised by reporting frequencies and percentages. Means and standard deviations were reported for items measured on a Likert scale. Data from the Standard procedures were followed for the analysis of CATA questions as recommended by Meyners *et al.* (2013). A frequency analysis was performed by counting how many respondents used each CATA term to describe the sample. To assess whether there was a significant association between consumers' taster status, the demographic characteristics of the consumers and the selection of emotional terms, cross-tabulation with phi coefficient and Cramer's V were performed. A significance level of $p < 0,05$ was used to identify statistically significant associations for all variables.

Guidance from SCS and the study leaders assisted the researcher during the data interpretation to ensure that the data were correctly interpreted. An overview of the variables that were analysed, together with the applicable statistical measures that were applied to reach each objective for the study, is showed in Table 3-2.

Table 3-2: Operationalisation of objectives

Objective		Section in questionnaire	Construct	Statistical analysis
1	To determine consumers' taster status	Section A (Addendum J) Section B (Addendum K)	**Classification of tasters** (PROP test paper taster status test) – Labelled magnitude scale (1 being ''barely detectable'' to 100 being ''strongest imaginable'') **Bitter food product likeness** – 5-point Likert scale (1 = dislike extremely, 2 = dislike very much, 3 = neither like nor dislike, 4 = like very much, 5 = like extremely)	Frequencies and percentages Mean and standard deviation
2	To determine consumers' consumption, purchasing behaviour and acceptance of sugar-free chocolate	Section C (Addendum L)	**General consumption** (no samples) **Purchasing behaviour** (completed for both samples) Multiple-choice questions **Taste experience** (completed for both samples) 5-point Likert scale (1 = dislike extremely, 2 = dislike very much, 3 = neither like nor dislike, 4 = like very much, 5 = like extremely); (1 = definitely would not buy, 2 = probably would not buy, 3 = might or might not buy, 4 = probably would buy, 5 = definitely would buy)	Frequencies and percentages Mean and standard deviation
3	To determine emotional lexicons for sugar-free chocolate for consumers with different taster statuses	Section D (Addendum M)	**Emotional lexicon** (completed for both samples) EmoSensory and CATA	Frequencies and percentages
4	To determine the association between emotional lexicons and consumers' taster status	Section A (Addendum J) Section B (Addendum K) Section D (Addendum M)	5-point Likert scale (1 = dislike extremely, 2 = dislike very much, 3 = neither like nor dislike, 4 = like very much, 5 = like extremely) EmoSensory and CATA **Emotional lexicon** (completed for both samples) **Taster status** (PROP test paper taster status test, no samples)	Phi and Cramer's V, cross-tabulation
5	To describe the demographic characteristics of consumers	Section E (Addendum N)	Age, gender, province	Frequencies and percentages, cross-tabulation

3.9 Reliability and validity

Reliability ensures that the research has consistent patterns and that the measurement instruments are stable (Richards & Morse, 2012; Stangor, 2015). This study considered internal reliability (internal consistency), which is used when the results need to be highly similar and consistent (Pietersen & Maree, 2016). The questionnaire that was used was designed to achieve the objectives of this study. Since most of the questionnaire was previously used and tested it increased the validity and reliability of the study. Validity in a study is achieved when a study is measuring what it had intended to measure (Carlson, 2012; Fink, 2009; McKenzie, 2014). This study made use of face, content and construct validity.

To ensure that face and content validity was achieved in the study, experts in the Department of Consumer Science who had a background in the research topic, namely the study leaders and the SCS of the NWU, were consulted in the design of the questionnaire after a thorough literature study had been done to ensure that the questionnaire assessed the defined content (see Foxall, 2015; Malhotra, 2011; Pietersen & Maree, 2016). In this study, validity was indicated on the success of the questionnaire in measuring what it had intended to measure to achieve the objectives that had been set for the study. Construct validity was used to ensure standardisation and to measure the different constructs that were covered in the questionnaire to determine how valid it was (see Pietersen & Maree, 2016), such as the consumers' emotional response towards sugar-free chocolate.

3.10 Ethical considerations

Ethical approval for the study was obtained from the Health Research Ethics Committee (HREC) of the Faculty of Health Sciences of the NWU (NWU-00490-20-A1) (refer to Addendum S). The execution of the study was within the parameters presented to the ethics committee.

3.10.1 Beneficence, non-maleficence and risk-benefit analysis

Beneficence has been ensured by protecting the respondents from all possible reasonable limits, including not being exposed to any injustice in the form of psychological, physical or financial harm, either intentional or unintentional (see Gravetter & Forzano, 2016). The panel of experts helped to identify the probable advantages and risks of the study and to ensure that the benefits of the study outweighed any potential risks (see Gravetter & Forzano, 2016; Walliman, 2011).

To ensure that the respondents participated voluntarily in this study and that possible coercion was restricted with no undue influence, the incentives that were given were appropriate to the study (see Babbie, 2013; Strydom, 2005; Walliman, 2011). Consequently, as a reward (Kumar, 2011), all the respondents received a complimentary cup of coffee or tea at the central location when they collected their sample bags.

The respondents have benefited indirectly from the study, as the research can contribute to the development of sugar-free products for consumers with different taster statuses. No more than minimal risk of harm was anticipated in the study, as the harm or discomfort that was anticipated for the respondents was not greater than ordinarily encountered in everyday life (see Greeff, 2019).

3.10.1.1 Physical risks

Minimal physical risk was expected, as the respondents were able to complete the questionnaire in 15 to 20 minutes. By keeping the questionnaire short, the risk of boredom was minimised (see Babbie, 2013; Maree & Pietersen, 2016a; Salkind, 2014). The respondents had the inconvenience of travelling to the central location in Potchefstroom. This risk was addressed by using only respondents residing in Potchefstroom at the time of the data gathering; hence, the respondents did not have to travel far to the central location. As the study made use of chocolate, the respondents were protected by providing them beforehand with all the information related to the ingredients of the chocolates that they had to consume so that they could identify any ingredients they might be allergic or sensitive to before agreeing to take part in the study.

Due to the outbreak of the Covid-19 pandemic, extra precautions were taken to guarantee the safety of the respondents. The following guidelines that had been set by the Department of Health (2020) were explained to the respondents in the e-mail they received from the research assistant after they had been successfully screened (Addendum D). The research assistant also reminded the respondents of these guidelines on the day they collected their sample bags.

- **Face masks:** The respondents had to wear a face mask before entering the central location (see Malan, 2020). Each individual that was involved in the study, such as the respondents, the research assistant and the researcher, wore a face mask at all times when he or she was in contact with others.
- **Sanitising:** Each person who entered the central location had to sanitise their hands before entering the premises of the central location (see Malan, 2020). An alcohol-based sanitiser was present at the entrance of the central location.

- **Social distancing:** To ensure social distancing, only one respondent was allowed at a time at the table where the chocolate samples were collected from the research assistant.

3.10.1.2 Psychological risk

Minimal psychological risk was expected, as there were no questions in the questionnaire that might cause emotional distress. The question on age (main questionnaire) was divided into groups and included an option “prefer not to say” for respondents who did not feel comfortable indicating their age (see Creswell, 2014; Kumar, 2011; Walliman, 2011). The respondents might have felt uneasy when answering questions related to their emotional responses. At the start of the survey, they were reminded that there were no right or wrong answers, that all the data collected were anonymous and confidential (see Botchway *et al.*, 2015; Fernandes *et al.*, 2015) and that their participation was voluntary – they could withdraw at any time without any consequences (see Strydom, 2005).

As the respondents were not requested to answer any questions that might affect their social wellbeing, minimal social risk was expected. With the advertisement of the study, precautionary actions were followed to ensure that everyone was welcome to participate in the study as long as they met the inclusion criteria. The respondents were reminded that the study would capture data on them as a group of respondents and not on individual respondents. The consent form also explained to them the importance of privacy and confidentially throughout the study (see Sections 3.10.1 and 3.10.1.4) (see Janse van Rensburg, 2014; Kempen *et al.*, 2012).

3.10.1.3 Economic and legal risks

Minimal economic risks were expected, as the respondents filled out the questionnaire online. Consequently, they needed to cover their bandwidth or data on their mobile phones. They did not have any loss of income or productivity, as they could complete the questionnaire at a time that best suited them. Their only other expense was the cost to travel to collect the sample bags from the central location. Seeing that the study made use of respondents in the Potchefstroom area, travelling was limited.

No legal risks were expected, as the study was conducted in an ethical manner. The NWU (licence holder) provided the researcher with access to the online survey software, QuestionPro©, to compile the electronic questionnaire. There were no legal problems at the end of the data collection.

3.10.1.4 Respect, dignity, autonomy and confidentiality

The respondents were treated with respect and dignity throughout the study. No dignitary risk was expected for the respondents or the researcher, as the questionnaire did not contain any questions that violated any personal beliefs or values.

As the study made use of independent recruitment (Facebook® and Instagram) and data collection (QuestionPro©), autonomy and voluntary participation were further established (see Babbie, 2013; Creswell, 2014). The researcher upheld the anonymity, confidentiality and right to privacy of the respondents by managing the information with respect to prevent any negative repercussions related to their participation (see Gravetter & Forzano, 2016; Matthews & Kostelis, 2011; Salkind, 2014). Because the respondents were fully informed about the study's aim, they were able to make an educated decision about whether or not they wanted to voluntarily participate (see Farahmand *et al.*, 2012; Janse van Rensburg, 2014; Soldavini *et al.*, 2012; Strydom, 2005). In doing so, each respondent was ensured of respect, dignity and autonomy, as they were allowed to make a decision that best served their interests (Babbie, 2013; Gravetter & Forzano, 2016; Tubaro, 2019).

3.10.2 Relevance and value

A study needs to be relevant and useful to benefit all of the stakeholders (Babbie, 2013; Creswell, 2014; George, 2016; Kumar, 2011). Therefore, a thorough literature review regarding the emotional response of consumers' taster status and their consumption behaviour of sugar-free chocolate was conducted, and appropriate research questions were formulated to address the limited research done in this context (see Gunaratne *et al.*, 2019; Li *et al.*, 2019). Consequently, this research may contribute to the existing knowledge and underexplored phenomenon of the influence of consumers' taster status on sugar-free chocolate (see Gunaratne *et al.*, 2019) in a South African context.

3.10.3 Scientific integrity

The researcher had a responsibility towards the stakeholders (e.g. being honest and treating all respondents with respect and kindness) to conduct the research in a transparent manner (see Creswell, 2014; Walliman, 2011). To achieve this, before the respondents' participation, the research assistant sent a leaflet via e-mail to the respondents after being successfully screened (Addendum D), containing information on the prospective study to enable informed and voluntary participation (see Babbie, 2013; Kumar, 2011; Strydom, 2005). The research assistant sent this leaflet to the respondents upon completion of the screening questionnaire.

The Scientific Committee and the Health Ethics Committee determined that the expected outcomes of the study were relevant and would hold value to the stakeholders (see Babbie, 2013; Salkind, 2014). Scientific integrity was further strengthened, as the researcher did not ask the respondents any personal, inappropriate or unnecessary information that was not related to the study (see Creswell, 2014; Walliman, 2011). The approval of the study by the Scientific Committee and the HREC ensured that the study had a suitable research design that measured what it intended to measure, that the sampling technique with the data collection tool was in accordance with the objectives of the research (see Bickman *et al.*, 2009; Gravetter & Forzano, 2016; Kumar, 2011) and that the study was performed in a fair and just manner.

3.10.4 Fair selection, justice, equity and participation

A convenient sampling technique was applied with an online recruitment strategy to ensure that the study would have an equitable inclusion of a heterogeneous sample of South African consumers from the target population (see Creswell, 2014; Gravetter & Forzano, 2016; Heiman & Lowengart, 2014; Koen, Wentzel-Viljoen & Blaauw, 2018; Walliman, 2011). This study made use of widely accessible, independent, electronic recruitment tools (Facebook® and Instagram) (see Dean *et al.*, 2015; Matthews & Kostelis, 2011) to promote fair selection and reduce vested interest (Babbie, 2013; George, 2016; Gravetter & Forzano, 2016). A panel of experts aided in formulating a well-contemplated, realistic, non-exploitative procedure that was implemented in the study (see Sieber, 2009) while meeting the ethical requirements.

3.10.5 Permission and informed consent

This study made use of voluntary participation and facilitated the exclusion of consumers who did not wish to contribute to the study (see Chiumento *et al.*, 2020; Farahmand *et al.*, 2012; George, 2016; Matthews & Kostelis, 2011). All potential respondents voluntarily contributed to the study by giving written electronic consent after being informed of what the study entailed (see Creswell, 2014; Koen, Wentzel-Viljoen & Blaauw, 2018; Kumar, 2011; Salkind, 2014; Tubaro, 2019). The respondents were provided with an electronic, written consent form (Addendum A) before the screening and main questionnaire (see Section 3.6) and could then carefully contemplate whether they wanted to participate in the study (see Gravetter & Forzano, 2016; Walliman, 2011). They provided consent electronically by selecting “I agree” and thereby indicating that they understood the information.

The respondents were reminded at the start of the questionnaire, that their participation was voluntary and that they could withdraw at any time (see Strydom, 2005) without any

discrimination or intimidating practices (see Salkind, 2014; Sieber, 2009). Even after they had collected their sample bags at the central location, they could still withdraw from the research without any penalty. In this instance, they could keep the sample bag. Five respondents collected a sample bag but did not complete the main questionnaire.

3.10.6 Privacy and confidentiality

The researcher ensured the anonymity of each respondent by not requesting any personal information (except their e-mail addresses for communication) (see De Vos *et al.*, 2011). All of the potential respondents were reassured of the confidentiality and privacy of the information that they provided and that the researcher would not use the information for any other reason that was not stipulated in the informed consent form (Addendum A) (see Kumar, 2011; Walliman, 2011). Using an independent data collection instrument (QuestionPro©) and anonymous completion of the electronic questionnaire by the respondents also contributed to the respondents' confidentiality and the privacy of the information they provided within the study (see Babbie, 2014; Botchway *et al.*, 2015; Salkind, 2014; Wood & Shukla, 2016).

3.10.7 Data management

The data were collected through the independent data collection platform QuestionPro© and were protected by a password to ensure confidentiality (see Walliman, 2011). Only the researcher, the study supervisors and the statistician were able to access the data from their password-protected computers for the duration of the study. As soon as the researcher completes her master's study, all the data and information about the study will be deleted from her computer. After the data had been transferred to a hard drive, the study supervisors deleted all the electronic data from their computers. The findings and raw data are kept safe by electronically storing these on a computer at the NWU in the Consumer Sciences building (F15), where the data and findings will be protected with a password for five years, as prescribed by the NWU.

3.10.8 Data and safety monitoring plan

The study data were accessible at all times for the researcher and study supervisors to review. They reviewed the study conduct (preparation of study materials, the process of recruitment, obtaining informed consent, the collection of data and analysing the data) on a weekly basis. The researcher and study supervisors ensured that the respondents were informed of the risks involved in participating in the study by not allowing a respondent to participate if he or she had not signed the informed consent form. The study supervisors had years of experience in quantitative studies and were able to identify any problems that might occur. They followed

the correct producers to report and solve problems and had been approved by the scientific and ethical committees of the faculty. As the researcher and study supervisors had had the necessary training in ethics designed by the Faculty of Health Sciences of the NWU, the study was conducted in an ethical manner. The progress of the study and any developments were communicated to the ethics office during progress reports or otherwise immediately to the ethics office as needed during monitoring. There was no need to change anything in the study; therefore, no ethical steps were taken to make amendments for the study to be approved.

3.10.9 Research safety plan

The research assistant reminded the respondents during the collection of their sample bags at the central location that they should not participate if they are allergic to chocolate or sensitive to the ingredients. Should a respondent have an allergic reaction to the chocolate, they should immediately contact the research assistant (contact details were available on the informed consent form, e-mail correspondence and the questionnaire instructions) to be referred to the NWU clinic, where they were ensured that they would receive the appropriate treatment. The safety precautions and steps taken to guarantee the responders' safety are indicated in Section 3.7.3.1. No incident was reported to the study supervisors; therefore, it was not necessary to follow procedures to address such problems and thus no incident was reported in the semi-annual ethics report.

3.11 Conclusion

The methodology that was described in this chapter had been implemented to collect the data that were required to achieve the objectives and answer the research question of this study. A quantitative non-experimental, descriptive, cross-sectional study was conducted using a self-administered electronic questionnaire to collect quantifiable data. After the researcher had obtained ethical approval for the study, respondents were recruited via social media platforms on which electronic posters were posted. Those who were interested in the study followed the link on the advertisement to be screened. The successfully screened respondents collected their sample bags at the central location and received the link to the main electronic questionnaire via e-mail. The respondents (N = 153) tasted two chocolate samples and completed the main questionnaire. The data were captured through QuestionPro© and analysed with the IBM SPSS software. In accordance with the set objectives of the research, the results will be reported in the next chapter.

CHAPTER 4 RESULTS

4.1 Introduction

In this chapter, the researcher presents the findings from the main questionnaire that was conducted to gather data for the quantitative study. The study aims to develop an emotional lexicon for sugar-free chocolate based on consumers' taster status (NT, MT or ST) using the CATA methodology. Although 158 respondents participated in the study, only 153 respondents completed the questionnaire up to the last section (demographic characteristics). Therefore, the discrepancy with regard to the sample sizes that the analyses are based on is caused by the missing values within the data. Each table and figure indicate the total respondents for that section. This chapter first presents the results pertaining to the respondents' demographics, then the determination of the respondents' taster status with their chocolate consumption behaviour. These are followed by the development of an emotional lexicon for each taster status and, lastly, a discussion of the relationship between the respondents' demographic characteristics and their taster status.

4.2 Demographic characteristics of consumers

In order to provide a better perspective of the data of the study sample within the research context, the demographic characteristics are presented first in this chapter, even though it is the fifth objective of this study. Section E of the main questionnaire (Addendum N) is used to achieve this objective. The respondents were asked to provide demographic details on their gender, age and the origin of their geographic location. As explained in Chapter 3 (Section 3.7.1.5.6), the demographic characteristics used in the study were placed at the end of the main questionnaire, as the placement of these questions could influence the consumers' willingness to respond. Table 4-1 provides a summary of the demographic characteristics of the sample. A total of 153 respondents (male = 23,38%; n = 36 and female = 75,97%; n = 117) completely filled out the questionnaire. The younger age groups were largely represented, as 54,90% (n = 84) of the respondents were between the ages of 18 and 29 years, followed by respondents between 30 and 39 years (n = 35; 22,88%). Respondents of 60 years and older (n = 9; 5,88%) were less represented in the study. Most of the respondents' hometown location (province) was North-West (n = 126; 82,35%), followed by Gauteng (n = 10; 6,54%) and then an equal distribution between Free State and Limpopo (n = 5; 3,27%).

Table 4-1: Demographic profile of respondents (N = 153)

Demographic characteristics	Frequency (n)	Percent (%)
Gender		
Male	36	23,38
Female	117	**75,97**
Other	1	0,65
Age in years		
18-29	84	**54,90**
30-39	35	22,88
40-49	13	8,50
50-59	12	7,84
60 and older	9	5,88
Hometown location		
Eastern Cape	1	0,65
Free State	5	3,27
Gauteng	10	6,54
KwaZulu-Natal	1	0,65
Limpopo	5	3,27
Mpumalanga	3	1,96
Northern Cape	2	1,31
North-West	126	**82,35**
Western Cape	0	0
Location for completing questionnaire		
At home	132	**86,27**
At the central location	7	4,58
Other	14	9,15

Note: Bold = the highest score for the variable.

The respondents were asked to fill out the questionnaire at a time and place that best suited them, although it was recommended that they complete the main questionnaire where they would usually consume chocolate in order to mimic a “natural” setting where the consumption of chocolate usually took place. The majority of the respondents completed the questionnaire at home (n = 132; 86,3%), while 9,2% (n = 14) chose “other” (i.e. mainly at work). Kong *et al.* (2020) found that the context had no significant impact on the chocolate tasting experience and that consumers may be prone to focusing solely on the chocolate tasting due to attention bias that may be affected by context environments.

4.3 Consumers' taster status

The first objective of the study was to determine the consumers' taster status (Sections A and B in the questionnaire). Section A in the questionnaire (Section 3.7.1.5.2) determined the respondents' taster status from performing the PROP taster status test. The respondents were classified according to the level of bitterness they could taste, using a LMS. This scale ranged from 1 being "barely detectable" to 100 being "strongest imaginable". The cut-off criteria for the tasting groups' classification were as follows: NT between 0 and 15,5; MT between 15,5 and 51; and ST above 51 (Sollai *et al.*, 2017; Tepper *et al.*, 2001; Zhao *et al.*, 2003).

Figure 4-1 indicates the distribution of the three taster status groups. There is an almost equal distribution of respondents between NT (38,6%) and MT (39,9%). The remainder of the respondents are classified as ST (21,5%). The distribution of the taster groups is similar to the distribution in a study done by Deshaware and Singhal (2017a), who reported ST as 25,95%, and MT and NT as 32,06% and 41,98%, respectively, in their study.

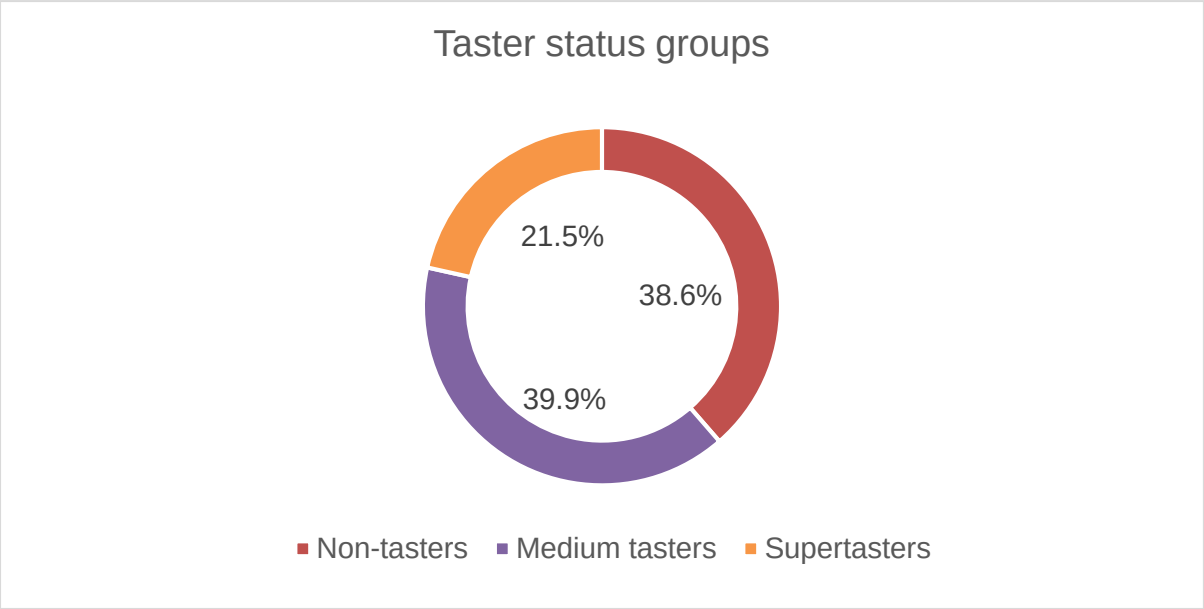

Figure 4-1: Distribution of respondents (N = 158) in taster status groups

4.3.1 Rating bitter food products to determine taster status

In Section B of the main questionnaire (Section 3.7.1.5.3), the respondents answered the question “Please indicate how you feel about the following food products by selecting the appropriate box using a scale from 1 to 5, where 1 indicates an extreme dislike, and 5 indicates an extreme like”. This question also answers the first research objective, as the consumers’ selection of bitter-tasting foods gave information on their taster status. The 14 food products were rated on a five-point Likert scale (Table 4.2) and interpreted as follows: <1,5 as dislike extremely; ≥1,5 to <2,5 as dislike very much; between ≥2,5 and <3,5 as neither like nor dislike; ≥3,5 to <4,5 as like very much; and lastly ≥4,5 as like extremely.

Since the respondents did not taste the food products, it might have influenced their liking for brassicaceaous vegetables (e.g. broccoli, brussels sprouts, cabbage and spinach), as consumers have their own perception and understanding of how these food products are prepared and served (Ervina *et al.*, 2020; Neugart *et al.*, 2018). This may explain why spinach (mean = 3,99; SD = 1,03) has a high frequency in “liked very much” compared to brussels sprouts (mean = 2,64; SD = 1,24) with a high frequency in “neither like nor dislike”. Another possible reason may be due to brussels sprouts being extremely bitter because of the higher concentration of glucosinolates (sinigrin and progoitrin) that is found in them (Wieczorek *et al.*, 2018).

In the “like extremely” category (mean = ≥4,5), the respondents extremely liked nuts (mean = 4,54, SD = 0,69). Nuts can be consumed as a healthy snack in-between meals (Aghayan *et al.*, 2019) or even used as a meal replacement, as they are high in protein, which may explain why they are extremely liked. The respondents also seemed to like dark chocolate (mean = 4,08; SD = 1,14), spinach (mean = 3,99; SD 1,03) and broccoli (mean = 3,77; SD = 1,02) very much, as these food products fall into the “like very much category” (≥3,5 and <4). They may consume dark chocolate not only for the taste but possibly also due to the health benefits thereof, such as cardiovascular-related disorders, the alleviation of hypertension, the regulation of blood sugar and antioxidant protection (Patel *et al.*, 2019). Even though green tea (without sugar) falls into the “neither like nor dislike category” (≥2,5 and <3,5), it had the lowest mean and is leaning somewhat towards “dislike very much” (mean = 2,58; SD = 1,33). The results, therefore, indicate that the respondents did not like green tea (without sugar). A possible reason may be due to green tea being known for its bitterness and astringency flavour (Xu *et al.*, 2018), with sugar usually being added to reduce the bitterness of the green tea (Xu *et al.*, 2017).

Table 4-2: Respondents' (all taster status groups) (N = 158) liking for bitter food products

Food product	Percent (%)					Mean	SD
	1	2	3	4	5		
Broccoli	5,7	3,8	20,9	47,5	22,2	3,77	1,02
Brussels sprouts	25,9	16,5	31,6	19,6	6,3	2,64	1,24
Cabbage	8,9	7,6	34,2	36,7	12,7	3,37	1,08
Asparagus	17,7	12,7	29,1	25,3	15,2	3,08	1,30
Spinach	5,7	1,3	15,8	43,0	34,2	3,99	1,03
Grapefruit/pomelo	15,2	15,2	16,5	28,5	24,7	3,32	1,39
Tonic water	15,2	24,1	22,8	23,4	14,6	2,98	1,29
Black coffee (without sugar)	15,2	13,9	29,1	20,9	20,9	3,18	1,33
Dark chocolate	5,1	6,3	12,0	29,1	47,5	4,08	1,14
Grapefruit juice	7,0	15,2	25,3	27,2	25,3	3,49	1,22
Green tea (without sugar)	27,8	22,8	23,4	15,2	10,8	*2,58*	1,33
Legumes	12,7	14,6	32,9	27,2	12,7	3,13	1,19
Beer	17,1	17,1	28,5	24,1	13,3	2,99	1,28
Nuts	0,6	0	7,6	27,8	63,9	**4,54**	0,69

Notes: SD = standard deviation; Bold = the highest score for the variable; Italics = the lowest score for the variable; Likert scale: 1 = dislike extremely, 2 = dislike very much, 3 = neither like nor dislike, 4 = like very much, 5 = like extremely. Mean score interpretation: <1,5 = dislike extremely; ≥1,5 and <2,5 = dislike very much ≥2,5 and <3,5 = neither like nor dislike; ≥3,5 and <4,5 = like very much; and ≥4,5 = like extremely.

Respondents who rated the food products as 1 (an extreme dislike) and 2 (dislike very much) were placed in the ST group; those who rated the products as 3 (neither like nor dislike) were placed in the MT group; and respondents who rated the products as 4 (like very much) and 5 (like extremely) were placed in the NT group (Table 4-3). Half of the ST (50,6%; n = 80) indicated that they disliked green tea without sugar, whereas only 0,6% (n = 1) indicated that they disliked nuts. In the MT group, there was an almost equal distribution between most food products; however, cabbage showed the highest liking (34,2%; n = 54) among the respondents, although it had a mean score of 3,37, which indicated that they neither liked nor disliked cabbage. The MT indicated the lowest liking for nuts (n = 12; 7,6%). Contrary to the ST group, the majority of the NT (n = 145; 91,7%) indicated that they liked nuts. Additionally, brussels sprouts were noted as the least liked food item by NT (n = 41; 25,9%).

Table 4-3: Respondents' (N = 158) liking for bitter food products, per taster status group

Food product	ST		MT		NT	
Food product	n	%	n	%	n	%
Broccoli	15	9,5	33	20,9	110	69,7
Brussels sprouts	67	42,4	50	31,6	41	*25,9*
Cabbage	26	16,5	54	**34,2**	78	49,4
Asparagus	48	30,4	46	29,1	64	40,5
Spinach	11	7,0	25	15,8	122	77,2
Grapefruit/pomelo	48	30,4	26	16,5	84	53,2
Tonic water	62	39,3	36	22,8	60	38,0
Black coffee (without sugar)	46	29,1	46	29,1	66	41,8
Dark chocolate	18	11,4	19	12,0	121	76,6
Grapefruit juice	35	22,2	40	25,3	83	52,5
Green tea (without sugar)	80	**50,6**	37	23,4	41	26,0
Legumes	43	27,3	52	32,9	63	39,9
Beer	54	34,2	45	28,5	59	37,4
Nuts	1	*0,6*	12	*7,6*	145	**91,7**

Notes: Bold = the highest score for the variable; italics = the lowest score for the variable.

4.3.2 Chocolate consumption behaviour

The second objective of this study was answered in Section C of the main questionnaire, focusing on the respondents' chocolate consumption and purchase intention of chocolate, as well as the sensory acceptance of sugar-free chocolate (Section 3.7.1.5.4). Table 4-4 provides an overview of the consumers' chocolate consumption and purchasing behaviour. In answer to the first question, the respondents had to indicate how often they consumed chocolate. Most of the respondents (32,9%; n = 52) consume chocolates at least once a week, followed by those consuming chocolate more than twice a week (25,9%; n = 41). These findings confirm the respondents' regular chocolate consumption. Majority of the respondents (58,2%; n = 92) indicated that the main reason for their consumption of chocolate was for emotional satisfaction (indulgence). It may be due to cravings (Velarde *et al.*, 2018), elevated mood and energy levels or because it is seen as pleasurable, relaxant, aphrodisiac and as an antidepressant (Macht & Dettmer, 2006). It is similar to what has been found by Gunaratne *et al.* (2019), who also found that in their sample group, the majority of the respondents consumed chocolate at least once a week, ate chocolate for satisfaction (indulgence) and indicated that flavour was the main reason for their purchasing chocolate.

The main considerations when purchasing chocolate for own consumption are flavour (75,3%; n = 119), followed by brand (16,5%; n = 26) and price (8,2%; n = 13). These findings are supported by those of Yu (2016), who revealed that buyers of chocolate were encouraged to

purchase a bar of chocolate if they saw a new flavour in store. According to the data, the respondents did not choose packaging or another reason as a consideration when purchasing chocolate.

Table 4-4: Consumers' (N = 158) chocolate consumption and purchasing behaviour

Item on scale	Frequency (n)	Percent (%)
Frequency of chocolate consumption		
Daily	11	7,0
More than twice a week	41	25,9
Twice a week	28	17,7
Once a week	52	**32,9**
Once a month or less	26	16,5
Reason for chocolate consumption		
For emotional satisfaction (indulgence)	92	**58,2**
To overcome hunger	0	0
Regard it as healthy	1	0,6
As a habit	38	24,1
Other reason	27	17,1
Considering factors when purchasing chocolate		
Brand	26	16,5
Flavour	119	**75,3**
Price	13	8,2
Packaging	0	0
Other reason	0	0

Note: Bold = the highest score for the variable.

4.4 Sensory acceptance of and intention to purchase sugar-free chocolate

To further achieve the second research objective, the respondents had to taste two sugar-free chocolate samples, namely milk chocolate (Sample 1) and dark chocolate (Sample 2). Table 4-5 gives an overview of the respondents' taste, aftertaste and purchase intent regarding both chocolate samples. For both chocolate samples, overall, the mean value falls into the "like very much" category. Hence, the respondents liked the taste and aftertaste very much and would most probably buy both chocolate samples. For milk chocolate, taste had a mean of 3,95 (SD = 0,80), and 54,4% (n = 86) of the respondents indicated that they liked the taste very much and 22,8% (n = 36) extremely liked the taste. For dark chocolate, taste had a mean of 4,09 (SD = 0,97), and 34,8% (n = 55) of the respondents liked the taste very much, while 41,4% (n = 65) of the respondents extremely liked the taste. Consequently, the respondents indicated a greater liking in taste for dark chocolate over milk chocolate. This may be due to the perception that milk chocolate should be sweet, as most of the familiar brands of milk

chocolate contain high quantities of added sugar and usually do not contain sweeteners that can affect the taste.

As milk chocolate normally contains added sugar, the sweetness thereof has been identified as a main reason for liking it (Alcaire *et al.*, 2017; Bayarri *et al.*, 2011; Oliveira *et al.*, 2015). When the respondents had to provide additional comments on the chocolate samples, some of them objected to the taste of the milk chocolate, stating that "something is missing from the recipe", that it has a "weird", "bland", "plastic" or "oily" taste and that they felt that the chocolate "could be more sweet" (Addendum P). These comments could possibly be ascribed to the lower dietary fibre content and higher sodium content of milk chocolate compared to dark chocolate (see Chapter 3, Table 3-1). This explains why the respondents enjoyed the dark chocolate more than the milk chocolate, as dark chocolate is usually not as sweet due to the high quantity of cocoa present (see Son *et al.*, 2018). For dark chocolate, the respondents stated that they "love the bold flavours", that the chocolate was "not too bitter" and that it was "not as bitter as a Lindt dark chocolate" (Addendum Q).

Table 4-5: Taste and aftertaste of and purchase intent for sugar-free chocolate (N = 158)

	Frequency (n)					**Percent (%)**					**Mean**	**SD**
	1	**2**	**3**	**4**	**5**	**1***	**2***	**3***	**4***	**5***		
Milk chocolate (Sample 1)												
Taste	3	2	21	86	36	1,9	1,3	19,6	**54,4**	22,8	3,95	0,80
Aftertaste	3	10	40	71	34	1,9	6,3	25,3	**44,9**	21,5	3,78	0,92
Purchase intent	7	16	20	65	50	4,4	10,1	12,7	**41,1**	31,6	3,85	1,11
Dark chocolate (Sample 2)												
Taste	2	10	25	55	65	1,3	6,6	15,8	34,8	**41,4**	4,09	0,97
Aftertaste	8	11	22	63	53	5,1	7,0	13,9	**39,9**	33,5	3,90	1,102
Purchase intent	7	17	16	50	67	4,4	10,8	10,1	31,6	**42,4**	3,97	1,171

Notes: Bold = the highest score for the variable; SD = standard deviation; Likert scale: 1 = dislike extremely, 2 = dislike very much, 3 = neither like nor dislike, 4 = like very much, 5 = like extremely. 1*= definitely would not buy, 2*= probably would not buy, 3*= might or might not buy, 4*= probably would buy, 5*= definitely would buy. Mean score interpretation on taste and aftertaste: <1,5 = dislike extremely; ≥1,5 and <2,5 = dislike very much; ≥2,5 and <3,5 = neither like nor dislike; ≥3,5 and <4,5 = like very much; and ≥4,5 = like extremely.

The aftertaste of the milk chocolate shows a mean of 3,78 (SD = 0,92) and was liked very much by 44,9% (n = 71) of the respondents and extremely liked by 21,5% (n = 34). The

aftertaste of the dark chocolate shows a mean of 3,90 (SD = 1,102) and was liked very much by 39,9% (n = 63) of the respondents and extremely liked by 33,5% (n = 53). It would seem that more respondents very much liked the aftertaste of the milk chocolate; however, more respondents extremely liked the aftertaste of the dark chocolate. When only considering the means, it would seem that the aftertaste of the dark chocolate (mean = 3,9; SD 1,10) (Table 4-5) was mostly preferred. For the milk chocolate, the respondents mentioned that the aftertaste was “quite bitter considering it’s the milk and not dark chocolate” and that it had a “slight metallic”, “flat”, “lingering milky” and “oily” aftertaste (Addendum Q). For the dark chocolate, the respondents indicated that the aftertaste was “pleasant” and “not as bitter” (Addendum Q).

Considering the consumers’ purchase intent of the chocolate samples, 41,4% (n = 65) and 31,6% (n = 50) would probably purchase the milk and dark chocolate, respectively, and 31,6% (n = 50) and 42,7 % (n = 67) would definitely purchase the milk and dark chocolate, respectively. This means that most of the respondents would rather purchase the dark chocolate (mean = 3,97; SD = 1,17) (Table 4-5). Furthermore, the respondents indicated that they would purchase the milk chocolate “for others”, while for the dark chocolate, they would “definitely buy this and eat it every day” (Addendum Q).

There are a several reasons that could have an impact the consumers’ willingness to purchase a chocolate bar, which include the chocolate category, the nutritional value and the health claims of the product (Kaur *et al.*, 2017). Since the respondents knew that they tasted sugar-free chocolate samples, it might have had an impact on their answers. When purchasing or consuming chocolate, taste is very important, although the perception of taste varies greatly from person to person (Thaichon *et al.*, 2018). Taste is still the most influential factor influencing chocolate consumer behaviour (Poelmans & Rousseau, 2016; Rousseau, 2015). In addition, Vecchio and Annunziata (2015) confirm the impact of demographics, such as gender and age, on consumers’ intention to purchase chocolate, as the general willingness to pay for chocolate is higher among female consumers and the elderly.

4.5 Emotional lexicon for chocolate samples

4.5.1 Emotions experienced during chocolate consumption

To address the third objective of this study, the respondents consumed the two chocolate samples and checked all the applicable emotions they felt while consuming the chocolate in Section D of the main questionnaire. Table 4-6 captures the identified emotions for the two samples. The emotions have been categorised as positive, negative and unclassified based

on the EsSense25 classification (see King & Meiselman, 2010). The table further captures the frequency and percentages of responses. If a specific emotion was not selected (e.g. nervousness with milk chocolate), a value of zero has been indicated, meaning that the emotion was not experienced during consumption. Overall, most of the respondents chose positive emotional terms for the list to express their emotional responses towards both chocolate samples. This conclusion is supported by prior research that found that consumers mainly respond using positive emotion terminology when engaging with food and beverages (Low *et al.*, 2021; Ng *et al.*, 2013; Ristic *et al.*, 2019; Silva *et al.*, 2019).

Table 4-6: Consumers' (N = 158) emotions with regard to sugar-free chocolate

Emotion	Frequency (n)		Percent (%)	
	Milk	Dark	Milk	Dark
Positive				
Contented	57	56	36,1	35,4
Desire	20	39	12,7	24,7
Enthusiastic	10	22	*6,3*	*13,9*
Glad	27	36	17,1	22,8
Good	82	84	51,9	53,2
Happy	69	63	43,7	39,9
Pleasant	89	78	56,3	49,4
Satisfied	91	85	**57,6**	**53,8**
Negative				
Disappointed	19	16	**12**	10,1
Discontented	4	8	2,5	5,1
Disgust	5	8	3,2	5,1
Dissatisfied	14	16	8,9	**10,1**
Guilty	15	5	9,5	3,2
Nervous	0	4	*0*	2,5
Sad	4	3	2,5	*1,9*
Unpleasant surprise	6	14	3,8	8,9
Unclassified				
Calm	82	69	51,9	43,7

Notes: Bold = the highest score for the variable; italics = the lowest score for the variable; Sample 1: sugar-free milk chocolate, Sample 2: sugar-free dark chocolate; respondents could choose any emotions they felt while consuming the chocolate samples.

The highest positive emotion selected for both the milk (n = 91; 57,6%) and the dark chocolate (n = 85; 53,8%) was satisfied. This indicates that the majority of the respondents experienced feelings of satisfaction when they tasted the samples. From the list of positive emotions, enthusiastic was the least selected emotion for both samples – milk (n = 10; 6,3%) and dark

chocolate (n = 22; 13,9%). Although enthusiastic was the least selected, the data indicate that the respondents were more enthusiastic about the dark chocolate (Table 4-6).

From Table 4-6, it appears that the respondents experienced contentment in equal amounts for both samples. The emotions of desire (n = 39; 24,7%), enthusiastic (n = 22; 13,9%), glad (n = 36; 22,8%) and good (n = 84; 53,2%) show a higher frequency for the dark chocolate than for the milk chocolate. The respondents also indicated that they felt happier (n = 69; 43,7%) while consuming the milk chocolate and that it was more pleasant (n = 89; 56,3%) than the dark chocolate. Although there was an equal distribution of positive emotions between the milk chocolate (content, happy, pleasant and satisfied) and the dark chocolate (desire, enthusiastic, glad and good), considering only the percentages, there was a higher liking for the dark chocolate.

The highest negative emotion selected for the milk chocolate (n = 19; 12%) and the dark chocolate (n = 16; 10,1%) is disappointed. The second-highest negative emotion is dissatisfied for the dark chocolate (n = 16; 10,1%). Although disappointment is the highest selected negative emotion for both samples, it is almost equal to the lowest selected positive emotion (enthusiastic). Therefore, it seems that the respondents enjoyed both chocolate samples. The lowest negative emotion selected for the milk chocolate is nervous (n = 0; 0%). This indicates that none of the respondents felt nervous consuming the milk chocolate. For the dark chocolate (n = 3; 1,9%), sad is the lowest selected negative emotion.

Overall, the selection of negative emotions is very low, which indicates that the respondents mostly enjoyed the sugar-free chocolate samples. Some negative emotions show a higher frequency for the dark chocolate than the milk chocolate. The respondents indicated that they felt more disappointed (n = 19; 12%), guilty (n = 15; 9,5%) and sad (n = 4; 2,5%) when they consumed the milk chocolate. This may be due to a reason stated in Section 4.4, namely that consumers have the perception that milk chocolate should be sweet, and as the sample was a sugar-free milk chocolate, it was not as sweet, and therefore, they indicated feelings of sadness and disappointment when the milk chocolate was consumed. Another possible reason why the respondents felt guilty when they consumed the chocolate samples may be linked to negative food-related beliefs based on culturally conditioned views regarding slimness and body weight (Macht & Dettmer, 2006; Macht *et al.*, 2003). The respondents also felt more discontented (n = 8; 5,1%), disgust (n = 8; 5,1%), dissatisfied (n = 16; 10,1%) and nervous (n = 4; 2,5%), and experience an unpleasant surprise (n = 14; 8,9%) when they consumed the dark chocolate (Table 4-6). However, as previously mentioned, these percentages are very low.

Variations between milk and dark chocolate in terms of ingredients and sensory properties can influence consumers' consumption behaviour (Gunaratne *et al.*, 2019; Sørensen & Astrup, 2011). Therefore, it is significant that different emotional lexicons for milk and dark chocolate should be compiled, which has been achieved in this study. Figure 4-2 presents a spider plot for the emotional lexicons for milk and dark chocolate.

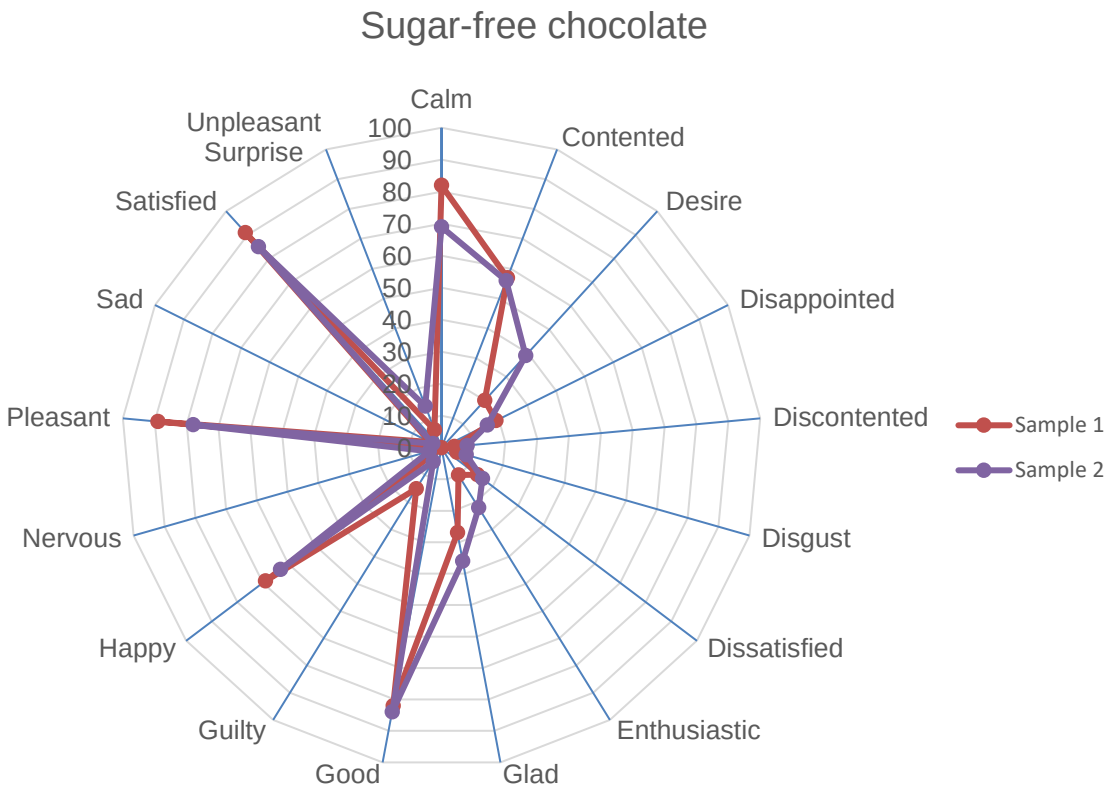

Figure 4-2: Emotional profile (%) of milk chocolate (Sample 1) and dark chocolate (Sample 2) for all taster status groups (N = 158)

4.5.2 Classification of the emotional experience during chocolate consumption

Since this study applied the CATA methodology and used a combination of emotions (positive [8], negative [8] and unclassified [1]), it gave the respondents the opportunity to accurately identify what emotions they experienced during chocolate consumption. The results point to an overall positive emotional experience (Table 4-6), which may be due to chocolate being seen as a popular and favourite food. A study by Laros and Steenkamp (2005) found a higher frequency of positive emotions in the consumption of favourite food. Macht and Dettmer (2006) have reported that due to chocolates sensory pleasure experienced both during and after consumption, chocolate mainly triggers positive emotions. In another study, Desmet and Schifferstein (2008) applied 22 emotion descriptors that were equally divided between positive

and negative emotions and found that when the respondents rated the relevance of these emotions during the tasting of various foods, positive emotions were reported to occur more compared to negative emotions.

The following positive emotions are relatively high compared to the other emotions: good (51,9% milk; 53,2% dark), happy (43,7% milk; 39,9% dark), pleasant (56,3% milk; 49,4% dark) and satisfied (57,6% milk; 53,8% dark). It is important to note that the unclassified emotion calm shows a high frequency (51,9% milk; 43,7% dark), indicating that the eating of sugar-free chocolate has a calming effect on the respondents (Table 4-6). A respondent indicated that they "really enjoyed the smell as well. It is calming" (Addendum Q). This may be due to neurophysiological components. Squicciarini and Swinnen (2016) explain that chocolate has a large amount of amino acids, particularly tryptophan, which raises the blood level of serotonin, a neurotransmitter that causes feelings of calming and pleasure.

An open-ended question (Section D of the main questionnaire) provided the respondents with the opportunity to include additional emotional terms during their chocolate consumption; these terms can be seen in Addendum P. The terms that the respondents gave are categorised as positive emotions, namely excitement, surprise, positive taste experience, curiosity, luxury and health related. Also mentioned were negative taste experience and uncertainty. A few emotional terms that were mentioned more than once for both chocolate samples are "nostalgic", "warm", "happy", "fancy", "loved", "pleasantly surprised" and "joy". Overall, the respondents included more positive emotions in their feedback. They indicated that they felt fancy, powerful, wealthy, accomplished and extravagant. This may be due to sugar-free chocolate being seen as a status symbol or an affordable luxury item (Mundel *et al.*, 2017). Chocolate is seen as a luxury due to the quality, price and uniqueness thereof (Hartmann *et al.*, 2017). Consumers in some segments, such as those with higher income levels and academic degrees, are prepared to pay a higher price for dark chocolate when attributes such as traditional claims and the country of origin are known (Otter *et al.*, 2018; Sepúlveda *et al.*, 2021).

4.6 Emotional terms according to consumers' taster status

To measure the emotional responses elicited by sugar-free chocolate, 17 emotional terms from the EmoSensory wheel (Schouteten *et al.*, 2015) were presented as a CATA question. In this study, the p-values are reported for the sake of completeness but will not be interpreted, as a convenience sample instead of a random sample was used (see Cilliers, 2019). The practical significance of the association between NT status and the emotion of contentment (positive emotion) (Table 4-7) leans towards a practically visible (phi = 0,216; p-value = 0,07)

difference for milk chocolate. In the NT group, 49,2% of the respondents indicated that they felt content after tasting the milk chocolate. The practical significance of the association between all the taster status groups combined and the content emotion (Addendum R) also leans towards a practically visible difference (phi = 0,22; p-value = 0,02) for milk chocolate.

For the guilty emotion (negative emotion) (Table 4-8), there is a practical significance for the NT status (phi = -0,212; p-value = 0,008), as only 1,6% of the NT selected this emotion for the milk chocolate. For the dark chocolate sample, there is a practical significance for the association between ST status and two negative emotions leaning towards a practically visible difference, that is, discontented (phi = 0,230; p-value = 0,004) and disgust (phi = 0,160; p-value = 0,044), seeing that 14,7% and 11,8% of the ST selected this emotion, respectively.

Since the rest of the emotions have a phi value of ~0,1 and a p-value greater than 0,05, there is a practically non-significant association or small effect between the consumers' taster status and their emotions. For the discontented emotion (Addendum R), the practical significance leans towards a practically visible difference (phi = 0,233; p-value = 0,014) for all the taster status groups combined for the dark chocolate. The practical significance of the association between all taster status groups and the calm emotion (unclassified emotion) (Table 4-9) leans towards a practically non-significant association for both the milk chocolate (NT: phi = 0,061, p-value = 0,444; MT: phi = -0,1, p-value = 0,229; ST: phi = 0,042, p-value = 0,6) and the dark chocolate (NT: phi = 0,009, p-value = 0,905; MT: phi = -0,04, p-value = 0,62; ST: phi = 0,036, p-value = 0,653). See Tables 4-7 and 4-9.

Table 4-7: Positive emotional terms selected by each taster status group

Positive emotions									
	Sample	**Contented**	**Desire**	**Enthusiastic**	**Glad**	**Good**	**Happy**	**Pleasant**	**Satisfied**
NT									
Percentage	Milk	49,2	8,2	3,3	14,8	50,8	39,3	**60,7**	52,5
	Dark	37,7	24,6	16,4	16,4	54,1	37,7	45,9	**55,7**
Phi value	Milk	0,216	-0,106	-0,099	-0,049	-0,017	-0,069	0,069	-0,082
	Dark	0,037	-0,002	0,057	-0,121	0,015	-0,035	-0,055	0,031
Significance	Milk	0,007*****	0,181	0,212	0,536	0,83	0,385	0,385	0,3
	Dark	0,637	0,983	0,477	0,129	0,852	0,659	0,49	0,698
MT									
Percentage	Milk	30,2	14,3	9,5	17,5	52,4	44,4	**58,7**	55,6
	Dark	31,7	22,2	9,5	28,6	**58,7**	47,6	55,6	55,6
Phi value	Milk	-0,1	0,04	0,107	0,008	0,008	0,013	0,039	-0,034
	Dark	-0,063	-0,046	-0,104	0,112	0,091	0,129	0,101	0,029
Significance	Milk	0,207	0,616	0,179	0,919	0,921	0,873	0,62	0,673
	Dark	0,429	0,559	0,193	0,158	0,254	0,105	0,205	0,718
ST									
Percentage	Milk	23,5	17,6	5,9	20,6	52,9	50	44,1	**70,6**
	Dark	38,2	29,4	17,6	23,5	41,2	29,4	44,1	**47,1**
Phi value	Milk	-0,137	0,079	-0,01	0,049	0,011	0,067	-0,129	0,138
	Dark	0,031	0,057	0,056	0,009	-0,126	-0,112	-0,055	-0,071
Significance	Milk	0,085	0,323	0,904	0,541	0,891	0,401	0,105	0,084
	Dark	0,701	0,47	0,479	0,907	0,114	0,16	0,49	0,374

Notes: 1 = Sample 1 (sugar-free milk chocolate), 2 = Sample 2 (sugar-free dark chocolate); Phi value indicates the effect sizes: ~0,1 practically non-significant associations, ~0.3 practical visible significance, ~0,5 practically significant. *Significance indicates the p-value: p <0,05 indicates that there is a statistically significant association. P-values are reported for completeness' sake but will not be interpreted, as an availability sample instead of a random sample was used.

Table 4-8: Negative emotional terms selected by each taster status group

Negative emotions									
	Sample	**Disappointed**	**Discontented**	**Disgust**	**Dissatisfied**	**Guilty**	**Nervous**	**Sad**	**Unpleasant surprise**
NT									
Percentage	Milk	**13,1**	3,3	4,9	9,8	1,6	X	4,9	1,6
	Dark	**11,5**	3,3	3,3	6,6	0	0	1,6	6,6
Phi value	Milk	0,027	0,038	0,079	0,027	-0,212	X	0,12	-0,09
	Dark	0,035	-0,065	-0,065	-0,094	-0,143	-0,128	-0,015	-0,064
Significance	Milk	0,738	0,635	0,318	0,732	0,008*****	X	0,13	0,26
	Dark	0,656	0,417	0,417	0,238	0,072	0,108	0,85	0,419
MT									
Percentage	Milk	12,7	0	1,6	9,5	**15,9**	X	0	4,8
	Dark	6,3	1,6	3,2	**14,3**	4,8	3,2	1,6	12,7
Phi value	Milk	0,017	-0,131	-0,073	0,019	0,177	X	-0,131	0,041
	Dark	-0,102	-0,129	-0,07	0,112	0,074	0,033	-0,019	0,11
Significance	Milk	0,832	0,099	0,356	0,811	0,026*****	X	0,099	0,606
	Dark	0,2	0,105	0,378	0,158	0,35	0,675	0,815	0,167
ST									
Percentage	Milk	8,8	5,9	2,9	5,9	**11,8**	X	2,9	5,9
	Dark	**14,7**	**14,7**	11,8	8,8	5,9	5,9	2,9	5,9
Phi value	Milk	-0,052	0,112	-0,007	-0,055	0,041	X	0,014	0,057
	Dark	0,079	0,23	0,16	-0,023	0,081	0,112	0,04	-0055
Significance	Milk	0,517	0,16	0,933	0,49	0,61	X	0,864	0,473
	Dark	0,318	0,004*****	0,044*****	0,776	0,307	0,16	0,615	0,49

Notes: 1 = Sample 1 (sugar-free milk chocolate), 2 = Sample 2 (sugar-free dark chocolate); x = no statistics are computed because it is a constant. Phi value indicates the effect sizes: ~0,1 practically non-significant associations, ~0,3 practically visible significance, ~0,5 practically significant. *Significance indicates the p-value: p <0,05 indicates that there is a statistically significant association. P-values are reported for completeness' sake but will not be interpreted, as an availability sample instead of a random sample was used.

Table 4-9: The unclassified emotion calm selected by each taster status group

Unclassified emotion		
	Sample	**Calm**
NT		
Percentage	Milk	55,7
	Dark	44,3
Phi value	Milk	0,061
	Dark	0,009
Significance	Milk	0,444
	Dark	0,905
MT		
Percentage	Milk	46
	Dark	41,3
Phi value	Milk	-0,1
	Dark	-0,04
Significance	Milk	0,229
	Dark	0,62
ST		
Percentage	Milk	55,9
	Dark	47,1
Phi value	Milk	0,042
	Dark	0,036
Significance	Milk	0,6
	Dark	0,653

Notes: 1 = Sample 1 (sugar-free milk chocolate), 2 = Sample 2 (sugar-free dark chocolate). Phi value indicates the effect sizes: ~0,1 practically non-significant associations, ~0,3 practically visible significance, ~0,5 practically significant. P-values are reported for completeness' sake but will not be interpreted, as an availability sample instead of a random sample was used.

A possible reason why there is no statistically significant association between the respondents' taster status and some of the emotional lexicons may be due to the smaller sample size. As discussed in Section 3.4.5, a sample size of 180 was needed to determine associations between taster status and emotional lexicons, but only 158 respondents participated in the study. Due to the outbreak of the Covid-19 pandemic, consumers might be more hesitant to leave their homes and take part in research studies (WHO, 2021). During the data collection (January 2021), South Africa was still in lockdown level 3 (South African Government, 2021), and consumers took extra safety precautions to protect themselves. Therefore, it was difficult to get respondents to participate in this study. The researcher endeavoured to recruit as many respondents as possible through advertising on social media platforms.

Even though there is no statistically significant association between the respondents' taster status and emotional lexicons, it is still interesting to see how the taster status groups selected the emotional terms. The NT indicates the lowest selection for the emotions desire (8,2%, milk), enthusiastic (3,3%, milk), glad (14,8%, milk), unpleasant surprise (1,6%, milk), guilty (0,0%, dark), nervous (0,0%, dark) and sad (1,6%, dark). The NT shows the highest selection in the emotions pleasant (60,7%, milk) and sad (4,9%, milk). This vast majority of respondents found the milk chocolate to be pleasant and did not feel nervous when consuming the dark chocolate. See Tables 4-7 and 4-8.

The MT reveals the lowest selection of the emotions discontented (0,0%, milk; 1,6%, dark), disgust (1,6%, milk) and sad (0,0%, milk). The MT shows the highest selection for the emotions guilty (15,9%, milk), glad (28,6%, dark), good (58,7%, dark), dissatisfied (14,3%, dark) and unpleasant surprise (12,7%, dark). This indicates that, overall, the majority of the MT show a low selection of negative emotions and a high selection of positive emotions for the dark chocolate.

The ST indicates the lowest selection for the emotions pleasant (44,1%, both samples), dissatisfied (5,9%, milk), good (41,2%, dark), happy (29,4%, dark) and satisfied (47,1%, dark). The ST shows the highest selection for the emotions happy (50,0%, milk), satisfied (70,6%, milk), calm (55,9%, milk), desire (29,4%, dark), enthusiastic (17,6%, dark), disappointed (14,7%, dark), discontented (14,7%, dark), disgust (11,8%, dark) and nervous (5,9%, dark). This indicates that the ST shows the lowest and highest selection of emotions for the dark chocolate, with the lowest selection of positive emotions and the highest selection of negative emotions. This may be due to STs' sensitivity towards a bitter taste, as dark chocolate is free of added sugar and more bitter due to its higher content in cocoa. See Table 4-10 for a summary of the highest and lowest selection of emotional terms per taster status.

Table 4-10: Summary of taster status selection of emotional terms

	Sample	NT	MT	ST
Highest selected emotion	Milk	**Pleasant** *Sad*	*Guilty*	**Happy** **Satisfied** Calm
	Dark	X	**Glad** **Good** *Dissatisfied* *Unpleasant surprise*	**Desire** **Enthusiastic** *Disappointed* *Discontented* *Disgust* *Nervous*
Lowest selected emotion	Milk	**Desire** **Enthusiastic** **Glad** *Unpleasant surprise*	*Discontented* *Disgust* *Sad*	*Discontented*
	Dark	*Guilty* *Nervous* *Sad*	**Pleasant** *Dissatisfied*	**Happy** **Pleasant** **Satisfied**

Notes: Bold = positive emotion; italics = negative emotion; calm = unclassified emotion; X = no selection.

As the third objective aims to determine an emotional lexicon for sugar-free chocolate for consumers with different taster statuses, an emotional lexicon is created for each taster status. Figures 4-3, 4-4 and 4-5 show the emotional lexicon per taster status group. In terms of the emotional lexicon, the three taster status groups are very similar, although there are a few differences. For the pleasant emotion, the NT indicates a higher selection (60,7%) than the ST (44,1%) for the milk chocolate. (Table 4-7). For the satisfied emotion, the ST is more satisfied (70,6%) than the NT (52,5%) for the milk chocolate, although ST are the least satisfied with the dark chocolate (47,1%). The ST feels more disappointed (14,7% dark), discontented (5,9% milk; 14,7% dark) and disgusted (11,8% dark) than the rest of the respondents (Table 4-8). The highest selection of unpleasant surprise is by the MT (12,7%) for dark chocolate.

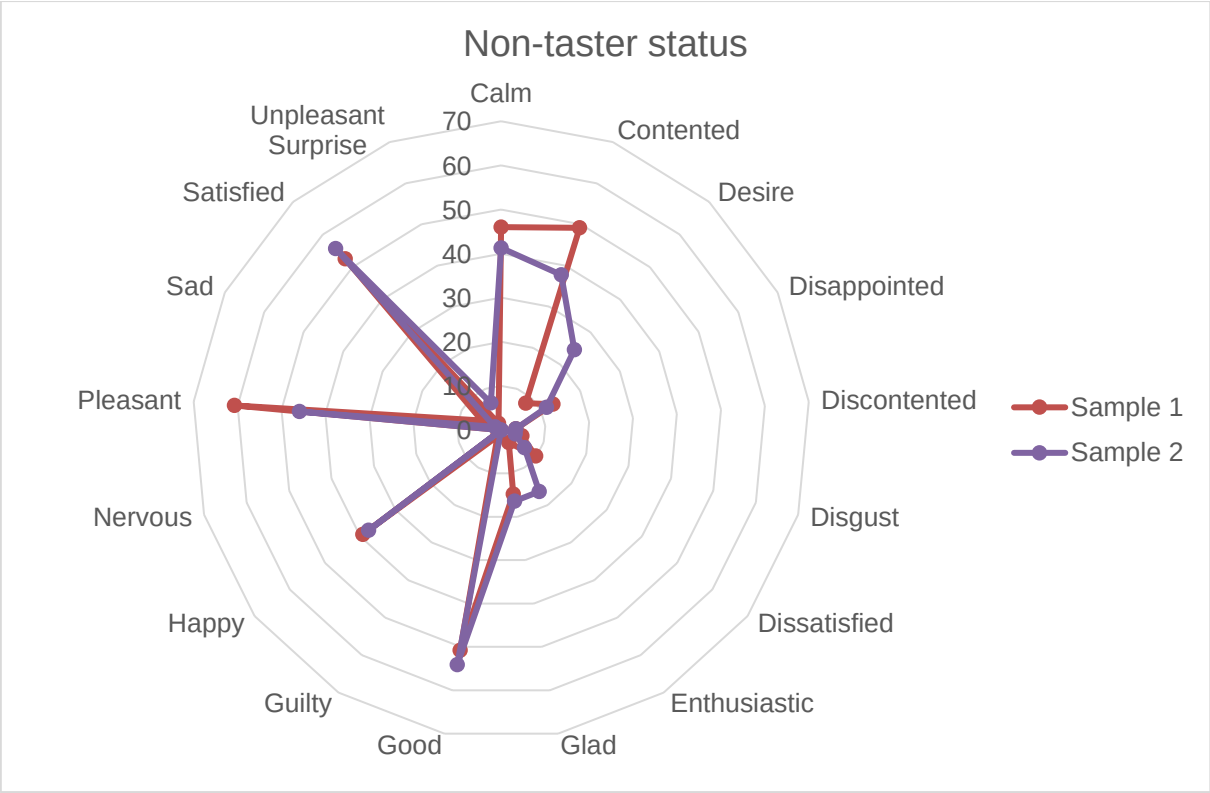

Figure 4-3: Emotional profile (%) of milk chocolate (Sample 1) and dark chocolate (Sample 2) for non-tasters

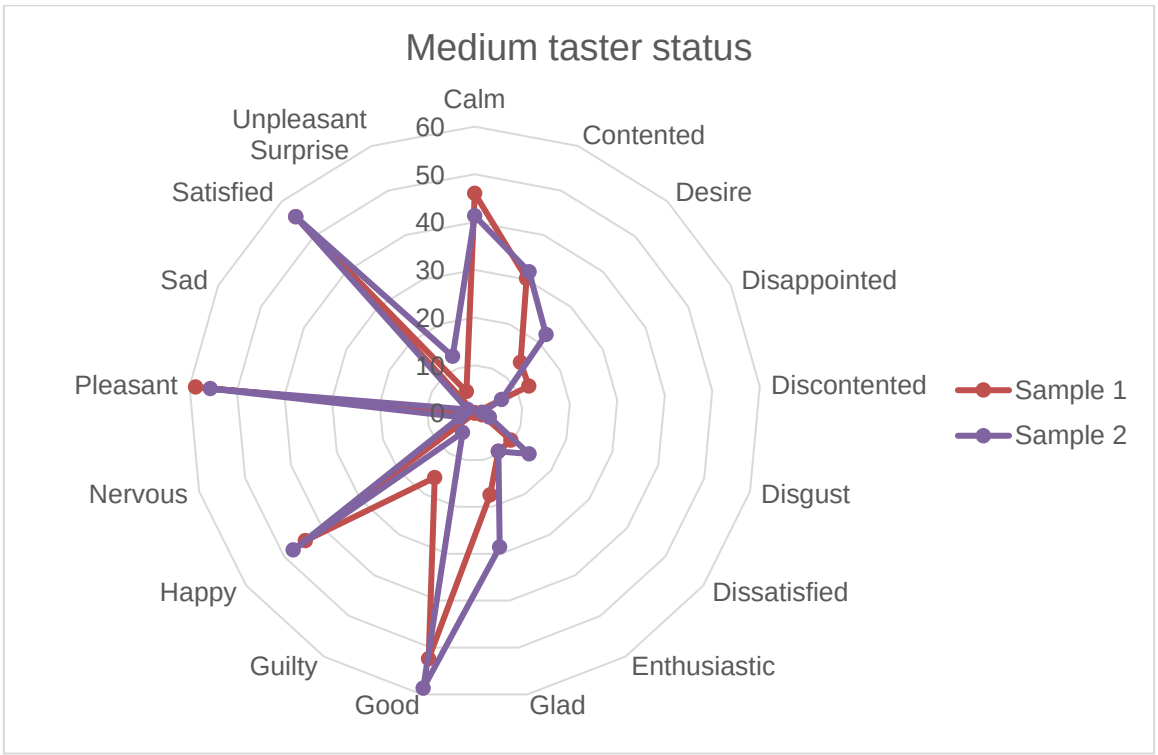

Figure 4-4: Emotional profile (%) of milk chocolate (Sample 1) and dark chocolate (Sample 2) for medium tasters

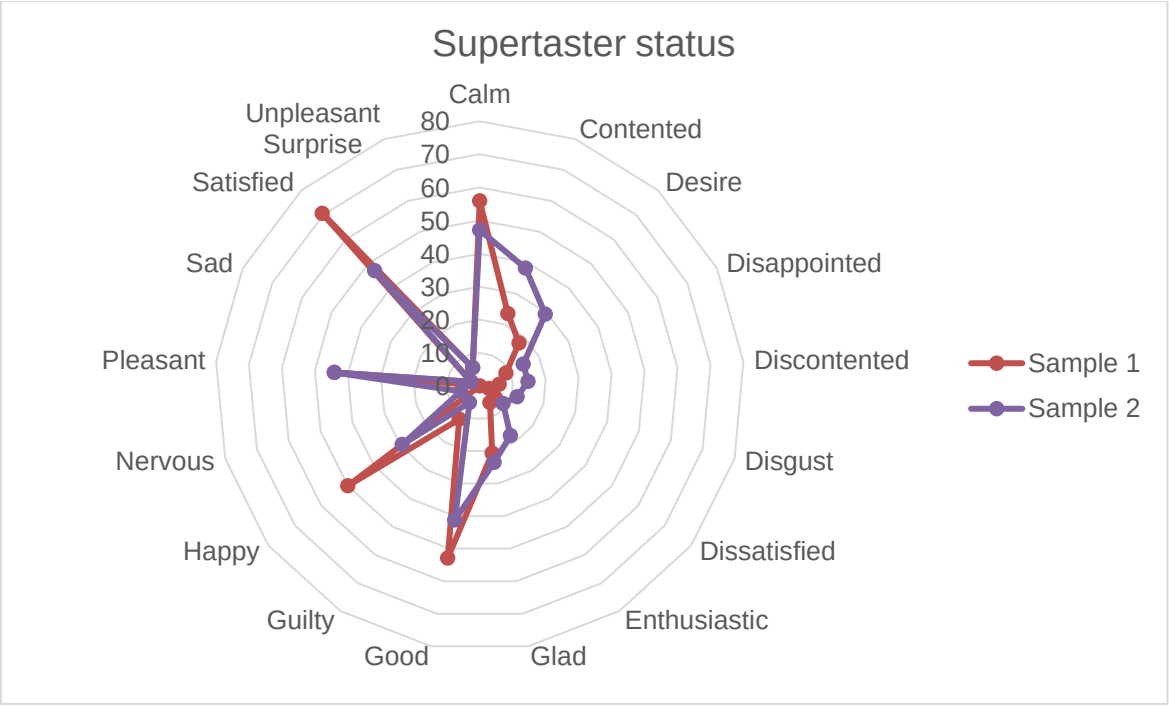

Figure 4-5: Emotional profile (%) of milk chocolate (Sample 1) and dark chocolate (Sample 2) for supertasters

4.7 Relationship between demographic characteristics and consumers' taster status

Based on the reported effect size (phi = 0,132; p-value = 0,264) (Table 4-11), there is a practically non-significant association between the respondents' gender and taster status. Half of the male respondents are classified as NT (50,0%), with the remainder being classified as MT (30,6%) and ST (19,4%). However, a larger proportion of the female respondents is classified as MT (41,9%), with the remainder of them being classified as NT (35,0%) and ST (23,1%). The findings are consistent with those of other studies that have found that women are more sensitive than men for bitter, sour, sweet and salty taste stimuli (Ervina *et al.*, 2020; Pingel *et al.*, 2010). Anatomical data support this gender difference due to the fact that female consumers have more taste buds and more fungiform papillae than their male counterparts (Khan & Lee, 2020; Prutkin *et al.*, 2000). Figure 4-6 presents a visual presentation of the findings.

Table 4-11: Statistical analysis of consumers' taster status based on demographic profile

		Taster status			Phi/Cramer's V	
		NT	MT	ST	Value	Sig
Gender	Male	50,0%	30,6%	19,4%	0,132	0,264
	Female	35,0%	41,9%	23,1%		
Age in years	18-29	27,4%	46,4%	26,2%	0,290	0,012*
	30-39	51,4%	40,0%	8,6%		
	40 and older	52,9%	23,5%	23,5%		

Phi value indicates the effect sizes: ~0.1 practically non-significant association, ~0,3 practically visible significance, ~0,5 practically significant. *Significance indicates the p-value: p <0,05 indicates that there is a statistically significant association. P-values are reported for completeness' sake but will not be interpreted, as an availability sample instead of a random sample was used.

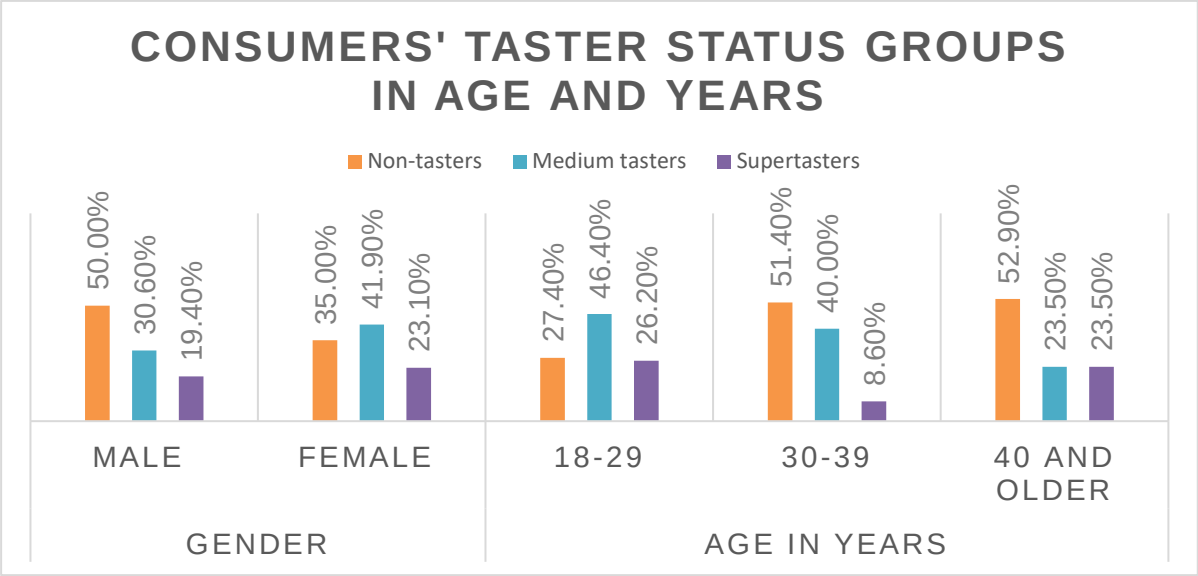

Figure 4-6: Consumers' taster status according to gender and age

The practical significance of the association between age and taster status leans towards a practically visible difference (phi = 0,205; p-value = 0,012) (Table 4-10). A larger proportion of 18- to 29-year-old respondents is classified as MT (46,4%), with the remainder of them being classified as NT (27,4%) and ST (26,2%). The taster status of the older groups seems to be less "intense", with little more than half of both groups being NT (51,4% of the 30- to 39-year-old respondents and 52,9% of the 40 years and older group). The remainder of the 30- to 39-year-old respondents are classified as MT (40,0%) and ST (8,6%). The remainder of the 40 years and

older are equally classified as MT (23,5%) and ST (23,5%). These results are supported by Puputti *et al.* (2019), who found that older respondents seemed to like and consume stronger tasting foods, as bitterness was not a barrier to liking compared to younger respondents who avoided bitterness. A possible explanation may be that older respondents are familiar with strong tastes after repeated exposure (Puputti *et al.*, 2019) or, as Doty *et al.* (2017) point out, older consumers cannot make fine taste distinctions due to their taste function declining with age. See Table 4-11 and Figure 4-6.

4.8 Conclusion

Sugar-free chocolate evoked different emotional terms from the respondents. The ST were more likely to dislike the bitter food products and checked more negative emotions compared to the MT and NT. It is, therefore, evident that emotional lexicons are needed for each taster status group, as emotional satisfaction is the main reason for chocolate consumption, and flavour is the most important factor for purchasing chocolate. The study also indicates that sugar-free milk and dark chocolate with sweeteners can be enjoyed, as the respondents mainly selected positive emotional terms. This research highlighted the significance of developing different emotional lexicons for consumers with different taster statuses, which confirms the existence of different consumer segments Future research into sensory acceptability will benefit from these emotional lexicons of and consumer behaviour with regard to chocolate and sugar-free products for the South African market.

CHAPTER 5 GENERAL DISCUSSION AND CONCLUSION

5.1 Introduction

Taste has a significant impact on consumers' food and beverage preferences (Belščak-Cvitanović *et al.*, 2015; Colares-Bento *et al.*, 2012), although the perception of taste is extremely personal (Thaichon *et al.*, 2018; Weiss *et al.*, 2010). This is due to taste sensitivity that varies in consumers (Tepper, 2008). Therefore, certain food products, such as food with a bitter compound, are avoided by consumers with a 25 TAS2R taste receptor gene, who are classified as ST (Herbert *et al.*, 2014; Sandell *et al.*, 2018; Varghese, 2018). Together with the ST group, consumers are also classified into the MT and NT groups (Ammann *et al.*, 2019; Yang *et al.*, 2019). Since consumers reveal emotions when they consume food products, these emotions can be measured (Kenney & Adhikari, 2016) and emotional lexicons can be developed to gain insight into consumers' choices (Gunaratne *et al.*, 2019).

This study aimed to develop an emotional lexicon for sugar-free chocolate based on consumers' taster status. Consumers' demographic characteristics were described, whereafter their taster status, general consumption and chocolate purchasing behaviour and acceptance of sugar-free chocolate were determined. These were followed by developing an emotional lexicon for sugar-free chocolate for each taster status and determining the association between emotional lexicons and consumers' taster status. This chapter will provide a summary of the main findings and a discussion of the conclusion, contribution, limitations and recommendations of the study.

5.2 Description of the sample (Objective 5)

Of the 158 respondents who participated in the study, 153 completely filled out the main questionnaire. The demographic profile of the respondents revealed that they were predominantly female (n = 117; 75,97%). Most of the respondents were relatively young consumers, between the ages of 18 and 29 years old (54,90%). Regarding their home town location, more than half of the respondents indicated that they lived in North-West Province (82,35%), and most of the respondents completed the main questionnaire at their home (86,27%).

5.3 Determination of consumers' taster status (Objective 1)

According to the PROP taster status test (Section 4.3), 38,6% of the respondents were classified as NT, 39,9% as MT and 21,5% as ST. Although the ST was in the minority, the distribution is in line with a study that indicates a distribution of 41,98% NT, 32,06% MT and 25,9% ST (Deshaware & Singhal, 2017b).

The respondents were classified into taster status groups according to their rating of bitter-tasting food products on a five-point Likert scale (Section 4.3). The rating of the food products revealed that the respondents' taster statuses affected their liking of food and beverages, as the ST disliked green tea (without sugar) and the NT liked nuts. Previous studies have also found that ST tend to have a low acceptability for green tea and rate it as more bitter compared to MT and NT (Akella *et al.*, 1997; Yackinous & Guinard, 2002b). Pasquet *et al.* (2002) indicate that this may be related to one's ancestors' taste genes being subjected to selective pressure; thus, potentially harmful foods are avoided.

5.4 Determination of consumers' consumption, purchasing behaviour and acceptance of sugar-free chocolates (Objective 2)

The results revealed that 32.9% of respondents (n = 52) consumed chocolate once a week, indicating the occurrence of chocolate consumption on a regular basis. The main reason indicated for consumption was for emotional satisfaction (indulgence) (n = 92; 58,2%). This finding was expected, as chocolate is also perceived by other studies to be an indulgence (Del Prete & Samoggia, 2020) and that the consumption of chocolate can increase consumers' mood and energy levels (Macht & Dettmer, 2006; Paoletti *et al.*, 2012; Velarde *et al.*, 2018). Reasons for general chocolate purchases included flavour (n = 119; 75,3%), brand (n = 26; 16,5%) and price (n = 13; 8,2%). This finding indicated that the consumers were willing to pay more for a chocolate bar if they enjoyed the flavour, but were also drawn towards specific brands and were likely to be influenced by the price of chocolate, such as specials. These findings are consistent with previous work by Gunaratne *et al.* (2019), who have also found flavour to be the main factor in purchasing chocolate and that chocolate is consumed for emotional satisfaction (indulgence).

Knowing what motivates consumers to purchase chocolate can help the confectionery industry to narrow its focus and resources on factors that will ensure success. As consumers' main reason to purchase chocolate is flavour, it is recommended that the food industry manages its resources, such as the use of consumers' taster status, which could reveal important information for product developers to improve the taste of sugar-free products. For example, due to ST being sensitive to bitter tastes, product developers should focus on developing new sugar-free products with less bitter-tasting notes. This could possibly lead to a higher success rate in the sugar-free market because more ST consumers will like and purchase these products, as both their specific taste preference and need to consume less sugar will be fulfilled.

This study made use of two sugar-free chocolate samples that were purchased at a local food retail company to determine consumers' taste experience. Chocolate Sample 1 was a bar of sugar-free milk chocolate, and Sample 2 a bar of sugar-free dark chocolate. After tasting both

samples, the respondents were asked how they felt about the taste and aftertaste of the chocolate samples and whether they would purchase these. Overall, the respondents enjoyed the dark chocolate more than the milk chocolate. For taste, the respondents extremely liked both the milk chocolate (n = 36; 22,8%) and the dark chocolate (n = 65, 41,4%). For aftertaste, the dark chocolate (n = 53; 33,5%) was liked more than the milk chocolate (n = 34; 21,5%). Considering the purchase intention, 31,6% (n = 50) and 42,7 % (n = 67) of the respondents indicated that they definitely would buy the milk and the dark chocolate, respectively. Hence, considering the occurrence of blind tasting, taste plays a major role in the choice and consumption of chocolate, as evidenced by the answers provided when the respondents were asked about their main reason for buying chocolate.

Sørensen and Astrup (2011) compared taste sensations and energy intake when dark chocolate and milk chocolate were consumed, and although they found that neither chocolate was liked more than the other, they did find that the dark chocolate promoted satiety. Their results also showed that after consuming the dark chocolate, the consumers showed a lower desire for something sweet and that the dark chocolate suppressed energy intake compared to the milk chocolate. An increase in the consumption of dark chocolate can be attributed to concerns regarding health-related problems while promoting health benefits that are associated with the consumption of dark chocolate (Sepúlveda *et al.*, 2021). Since consumers may strive to live a healthier lifestyle, sugar-free dark chocolate can be used as a healthier alternative to ordinary chocolate while still enjoying the taste.

5.5 Determination of the emotional lexicon for sugar-free chocolate for consumers with different taster statuses (Objective 3)

After tasting the two chocolate samples, the respondents indicated all the emotions they felt from a list consisting of positive, negative and unclassified emotions. Overall, the majority of the respondents chose positive emotions for both chocolate samples, with the highest selection being satisfied, pleasant, good, happy and content. The highest selected emotion for both milk chocolate (n = 91; 57,6%) and dark chocolate (n = 85; 53,8%) was satisfied, indicating that both chocolate samples were enjoyed by the respondents. Therefore, sugar-free chocolates can satisfy consumers without sacrificing enjoyment due to being a guilt-free option. These findings are consistent with previous research that also found when consuming food and beverages, consumers mainly experience positive emotions (Desmet & Schifferstein, 2008; Low *et al.*, 2021; Ng *et al.*, 2013; Piqueras-Fiszman & Jaeger, 2014; Ristic *et al.*, 2019; Silva *et al.*, 2019; Silva *et al.*, 2016). The open-ended question revealed that the respondents felt fancy, powerful, wealthy, accomplished and extravagant, which were categorised under luxury, when they consumed the dark chocolate. Thomson *et al.* (2010) indicated that respondents felt luxurious and sophisticated

while consuming dark chocolate and that the emotional terms “powerful” and “energetic” could be associated with the cocoa flavour, while the bitter taste is associated with being confident.

Successful lexicons could be created for each taster status, and although they were very similar, there were a few differences. For the milk chocolate, the NT showed a higher selection for the pleasant emotion compared to the ST. This can be due to the NT not being able to taste the bitterness of the sugar-free chocolate, which is caused by the cocoa, and the bitter aftertaste due to sweeteners, while the ST could taste the bitterness and found it unpleasant. The ST also felt more disappointed, discontented and disgust compared to the rest of the respondents.

Mintel (2021) indicated a new trend for 2021. The group explains that united by food, consumers desire the feeling of being unique and special while being part of communities of like-minded individuals in relation to their food and beverage choices. An emotion is a special perception that reveals information about consumers’ current physical state (Ferrarini *et al.*, 2010a), and it can have a unique influence on consumers’ behavioural responses (Jang & Namkung, 2009). Keeping the above-mentioned in mind, consumers’ emotions can be used in product development, ensuring that the focus is on the consumers while using their taster status to make alternative products that are alerted to the consumers’ taste and thereby ensuring that they have more food products to choose from.

Despite ST being in the minority (see Section 5.3), emotionally, they felt the most negative (Table 4-10). Ideally, sugar-free products should be made to evoke the highest selection of positive emotions from consumers, and the food industry should determine which positive emotions are the least selected so improvements can be made. The ST indicated the lowest selection for the emotions happy, pleasant and satisfied for the dark sugar-free chocolate. This may be ascribed to their high sensitivity towards bitter-tasting ingredients, such as the high cocoa content of dark chocolate. Owing to salt, which can mask bitter tastes, ST tend to consume more sodium (Hayes *et al.*, 2010; Nahar *et al.*, 2018). Therefore, a possible solution for product developers is to add different types of salt, such as Himalayan salt, to dark chocolate to mask the bitterness of the cocoa. In addition, these products can be marketed as “low in bitterness” or “saltier” to motivate ST to purchase these sugar-free alternatives.

The MT indicated the lowest selection of the pleasant emotion for the dark chocolate, since the larger proportion of MT may also be sensitive towards bitter tastes. Therefore, they may also prefer chocolate alternatives with a higher salt content. Among the NT, the lowest selection of positive emotions for the sugar-free milk chocolate was for desire, enthusiastic and glad. Therefore, the food industry can improve sugar-free milk chocolate by incorporating strong flavours, such as spicy elements (e.g., Cajun and star anise) or chillies.

5.6 Associations between emotional lexicons and consumers' taster status (Objective 4)

The results showed a practical significance of the association between NT and the content emotion (positive emotion) and the guilty emotion (negative emotion), respectively, for the milk chocolate. The results also revealed a practical significance for the association between ST and the discontented and disgust emotion. For the rest of the emotions, there was a non-significant association or a small effect for all the taster status groups. This was due to the sample size (n = 158) of the study, as explained in Chapter 4. The data were collected during the lockdown (level 3) due to the Covid-19 pandemic (WHO, 2021), and consumers were, therefore, hesitant to participate in research studies.

The results revealed that there was a practically non-significant association between the respondents' gender and taster status. Half of the male respondents were classified as NT (50%), with the remainder being classified as MT (30,6%) and ST (19,4%). The majority of the female respondents were classified as MT (41,9%), with the remainder of them NT (35,0%) and ST (23,1%). Spence (2019) reported in his study that they could not distinguish between male and female consumers in perceiving taste, although the findings showed that women (34%) were slightly more likely to be ST compared to men (22%). However, other studies have found that women are significantly more sensitive towards salty, bitter, sweet, and sour taste stimuli compared to men (Bolhuis *et al.*, 2018; Ervina *et al.*, 2020; Pingel *et al.*, 2010). Despite the findings presented above, the results of this study is in line with the above-mentioned results indicating that women are more likely to be ST, as supported by the results from Garneau *et al.* (2014).

There was a practically visible association between age and taster status, with the majority of the 18- to 29-year-old respondents being classified as MT (46,4%), with the remainder of them classified as NT (27,4%) and ST (26,2%). The other age groups were mainly classified as NT. The reason why the older age groups were mostly classified as NT may be due to their taste function declining with age (Doty *et al.*, 2017). Puputti *et al.* (2019) found that as age increased, consumers seemed to like and consume strong tastes, such as strong-tasting vegetables, as bitterness was not a barrier to liking these food products. Their findings indicate that most male respondents in the older age categories seem to be NT, and female respondents between the ages of 18 and 29 years are mostly classified as MT. The relationship between demographic characteristics and consumers' taster status reveals valuable information that can be used by marketers to target a set of consumers; for example, when product developers create a sugar-free food product that has bitter notes, they could rather target male consumers in advertisements, as female consumers are more likely to be ST. The same principle can be used with the age

groups; since ageing has a declining effect on the taste function (Doty *et al.*, 2017), older consumers can be targeted for stronger flavoured sugar-free products.

5.7 Contribution of the study

5.7.1 Significance for industry role players

This study highlighted the significance of developing different emotional lexicons for consumers with different taster statuses, which confirms the existence of different consumer segments. These emotional lexicons will contribute to future research on the sensory acceptability of and behaviour with regard to chocolate and sugar-free products for the South African market. Furthermore, the study contributed to essential knowledge about the motivation for purchasing and consuming sugar-free chocolate. The findings can provide insight on the influence of taste sensitivity and give some guidance to the confectionery industry and individuals who work with various methods of marketing communication strategies on making use of tasting notes to advertise their products. The results can be beneficial to the industry role players, as they can use these developed emotional lexicons in their product development to ensure that the product meets the need of consumers in different segments, which can potentially increase the success rate of their product. For example, the industry can run a targeted marketing communications campaign that focuses on Generation Z, influencing their perception of sugar-free dark chocolate by advertising it as an affordable luxury item.

5.7.2 Significance for the field of study

The research of this study contributes to the literature on consumers' PROP sensitivity, as there is a gap in existing research due to the avoidance of consumers' taste sensitivity and product influences or experiences in sensory information (Li *et al.*, 2019). Consumers' taster status (operationalised via PROP responsiveness) and the knowledge of chocolate could be essential factors in the nature of emotions towards chocolate, leading future studies to have a comprehensive understanding of consumers' behaviour with regard to sugar-free chocolate and other food products. The newly developed lexicons for sugar-free chocolate can be used in sensory consumer tests of other types of chocolate, such as dark, milk or white chocolate products. By adding the emotional element to affective tests, a powerful tool can be created that could be used to differentiate between samples that have similar acceptability levels. As a result, these emotional lexicons may be useful in future chocolate product acceptance studies. To the researcher's knowledge, this was the first study that examined the influence of sensory information with regard to sugar-free chocolate on consumers' taste sensitivity. Hence, this study can be regarded as an advantage in the sensory and consumer science field.

5.7.3 Significance for consumers

Since the industry and the academic field influence the consumer, the consumer can be influenced by this research indirectly by gaining from the initiatives the industry and the academic field may implement in response to the findings of this study. Therefore, consumers may have access to products that are focused on each taster status group, allowing them to enjoy products that have been altered to their taste sensitivity. This, in turn, may possibly lead to consumers choosing more sugar-free products. The respondents who took part in this study showed a high liking and purchase intent for the sugar-free chocolate samples they tasted, which may lead them to consider this healthy alternative when they purchase chocolate.

5.8 Limitations

During the data collection, difficulties were experienced regarding the respondents' response rate and the completion of the main questionnaire. As mentioned, this was mainly due to the challenges presented by the Covid-19 pandemic. To better describe and differentiate between the sugar-free chocolate samples, one should consider including a more extensive list of emotional terms that will identify unique relationships within chocolate samples. The products can be better differentiated by a larger number of emotional terms to evaluate food products (Jaeger *et al.*, 2018).

This study made use of a self-reported measurement by asking the respondents to indicate all of the emotions they felt during the chocolate tasting. This method relies on the respondents' ability to explicitly state their experienced emotions. However, this technique is normally used in research on food-elicited emotion, Thomson *et al.* (2010) explain that the more often, the focus is on the message the product conveys to the consumers instead of what the product does to them. This might also have been the case in this study, and it is, therefore, recommend that future research should place emphasis on the non-self-reported (implicit) measurement of emotion by measuring, for example, brain activities, facial expressions and skin conductance (Köster & Mojet, 2015). Lagast *et al.* (2018) explain that the ability to identify fast, uncontrollable emotional responses that may impact the like of and preference for food products that cannot be consciously acknowledged by respondents can be aided by facial expression.

5.9 Recommendations for future research

As the data had been collected from a non-probability purposively selected sample (N = 158), using an online questionnaire, the results could not be generalised to the entire South African population. However, it did broaden the understanding regarding consumers' emotional response to sugar-free chocolate. It is, therefore, recommended that similar future research should be

performed among a larger sample group with a higher representation of other provinces of South Africa, as such research would determine whether similar results would emerge or whether it would differ from the findings of this study.

Furthermore, the study could be replicated using different consumer groups (containing more male respondents, since 76% of the respondents in this study were female), and changes can be made to the data-collecting procedure to validate the generalisability of the methodology that was used in this study. The application of the methodology, scales and tools that were used to collect data can be used on other product categories to understand whether similar relationships between consumers' emotions and taster status exist beyond the chocolate segment. By using other product categories, more specific lexicons can be developed for the different taster status groups. As this study only made use of one brand of sugar-free milk chocolate and dark chocolate, it is recommended that different brands of sugar-free chocolate and sugar-free products should be used, as the ingredients and manufacturing process differ, which may have an effect on the taste. Consumers may then reveal different emotions, resulting in different emotional lexicons.

5.10 Final conclusion

Sugar-free milk chocolate and dark chocolate with sweeteners can be consumed and enjoyed as a healthier alternative. Furthermore, sugar-free chocolate evoked different emotional terms for consumers with different taster statuses. The ST group was more likely to dislike bitter food products and check more negative emotions compared to the MT and NT groups. This study contributed to sensory and consumer science research in a South African context; different emotional lexicons are required for each taster status, as the main reason for consuming chocolate is emotional satisfaction, and the main factor which influences purchases is flavour. These emotional lexicons will contribute to future research on the sensory acceptability of and behaviour with regard to chocolate and sugar-free products for the South African market.

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ADDENDUMS

Addendum A: Informed consent form

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INFORMED CONSENT FORM FOR SOUTH AFRICAN CONSUMERS IN CHOCOLATE RESEARCH STUDY

TITLE OF THE RESEARCH STUDY: Development of emotion lexicons for consumers' taster status to describe sugar-free chocolate

ETHICS REFERENCE NUMBERS: NWU-00490-20-A1

PRINCIPAL INVESTIGATOR: Prof. Annchen Mielmann (PhD Food Science)

POST GRADUATE STUDENT: Telana van Zyl (BSc Hons Consumer Science)

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You are being invited to take part in a **research study** that forms part of my Master's study. Please take some time to read the information presented here, which will explain the details of this study. Please ask the research assistant via e-mail to answer any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about and how you might be involved. Also, your participation is **entirely voluntary,** and you are free to say no to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part now.

This study has been approved by the NWU- HREC of the Faculty of Health Sciences of the North-West University (NWU-00490-20-A1) and will be conducted according to the ethical guidelines and principles of Ethics in Health Research: Principles, Processes and Structures (DoH, 2015)

and other international ethical guidelines applicable to this study. It might be necessary for the research ethics committee members or other relevant people to inspect the research records.

What is this research study all about?

- We plan to determine your consumer's taster status. This means that we would like to know if you are sensitive to bitter-tasting foods, e.g. beer, broccoli, coffee, and pomelo, to name a few. You will not have to taste these food products. We will only ask you questions about your sensitivity towards bitterness. Your sensitivity towards bitter-tasting foods will be determined through a scientific method where you will have to place a paper disk on your tongue and then rate the bitterness of the paper disk.

- We also want to understand your taste experience, consumption, and purchasing behaviour of chocolate is by asking you a few questions about your chocolate consumption and purchasing behaviour in general. Your taste experience will be determined through the tasting of two sugar-free chocolate samples. We would like to find out what emotions consumers experience when consuming sugar-free chocolates. The information you provide will used to develop emotional lexicons for the sugar-free chocolates.

- This study will be conducted in Potchefstroom, located in the North West Province, and will be done by experienced health researchers trained in Consumer Science research. A total of 180 respondents will be included in this study.

Why have you been invited to participate?

- You have been invited to be part of this research because you indicated your interest to be part of the research and are 18 years or older, understand the English language, and enjoy consuming chocolate. You also indicated that you do not have any allergies or are sensitive to the ingredients in chocolate.

- You will unfortunately not be able to take part in this research if you are using any medication, as this can affect your sense of taste, have specific dietary requirements not allowing the consumption of chocolate, or suffer from oral or gum diseases. If you do not have basic computer knowledge, you will not be able to take part in the study as the

What will be expected of you?

- You will be expected to complete an electronic screening questionnaire consisting out of 11 questions which take a maximum of 5 minutes. This is done to determine if you fit the

inclusion criteria of the study. You can complete the screening questionnaire at any place and time until the study reaches its desired number of consumers.

- It will be expected from you to come to the central location located in Potchefstroom to collect your sample bag. You will have to taste impregnated paper disks and two chocolates samples while you to complete a short questionnaire at your home.

- The main questionnaire consists of five sections and will take between 15 to 20 minutes to complete the questionnaire on an electronic platform called QuestionPro.

- At the central location where the sample bags will be collected, you will have to sanitize your hands. You will be required to wear a face mask for your and fellow consumers' health safety with regards to the global pandemic (COVID-19).

- You will receive e-mails from the research assistant once you were successfully screened to take part in the study, containing information about the study such as, a one week and one day reminder on the time and location of the collection of the sample bag at the central location in Potchefstroom, as well as the link to the main questionnaire after you collected your sample bag.

Will you gain anything from taking part in this research?

- There are no direct benefits to respondents in this study. An incentive will be provided as you will be able to receive a complementary coffee or tea at the central location when you collect the sample bag.

- You will contribute to a study that has never been done in South Africa, which will make a significant contribution to the Consumer Science and Sensory fields that will add to the limited existing knowledge. You will be able to see the results, which should be an interesting discovery.

- Additional gains of this study are for the researcher gaining knowledge and experience as the consumer will give the researcher insight on consumer’s taster status and their consumption behaviour on sugar-free chocolates.

Are there risks involved in you taking part in this research, and what will be done to prevent them?

- There is a risk for you to take part in the study. If you are allergic or sensitive towards any of the ingredients in chocolates, you should not participate in the study. If you are not sure

if you are allergic or sensitive to chocolate ingredients, you should also not participate in the study.

- Due to the outbreak of COVID-19, there is more risk coming to the central location. However, the risk will be limited by ensuring that you were a face mask and sanitize your hands when entering the central location. Social distancing will also be done by ensuring that only one person is allowed at a time at the table in the central location when you collect your sample bag.

- There is no need to be concerned about the accuracy of your answers, as there is no right or wrong answer in the questionnaire. We just want your honest opinion as the information you provide will only contribute to the purpose of the study.

- There are more gains for you in joining this study than there are risks.

How will we protect your confidentiality, and who will see your findings?

- The anonymity of your findings will be protected as we make use of the QuestionPro software program to conduct the survey. We will not record your name in any documentation that is used in this study. We will need an e-mail address that will only be used to contact you and send you the link to the main questionnaire after you have been successfully screened for the study. Your privacy will be respected throughout the study by the research team and the statistician. Your results will be kept confidential by all those that are involved in the research project as only the researchers, her supervisor and the statistician will be able to look at your findings. The Health Research Ethics Committee (HREC) of the Faculty of Health Sciences of the North-West University may inspect the results. Findings will be kept safe by electronically storing it on a computer at the NWU in the Consumer Sciences building (F15), where it will be protected with a password for five years.

What will happen with the findings?

- The findings of this study will only be used for this study and publication in articles, but no personal information will be made public.

How will you know about the results of this research?

- We will give you the results of this research after finalising it by posing a summary of the results, in a user-friendly format on the same platform that the study will advertise

(Facebook® and Instagram), for the consumers who participated in the study and others who are interested in the research findings.

- You will be informed of any new relevant findings by sending you an e-mail.

Will you be paid to take part in this study and are there any costs for you?

- There is minimal cost involved to participate in this study as you will have to travel costs to the central location to collect your sample bag and using data on your electronic device to complete the questionnaires, but you will not receive reimbursement for this expense.

- No, you will not be paid to take part in the study; however, you will be able to receive a complementary coffee or tea at the central location when you collect the sample bag.

Is there anything else that you should know or do?

- You can contact the research assistant at chocolatetastingstudy@gmail.com if you have any further questions or have any problems.

- You can also contact the NWU-Health Research Ethics Committee via Mrs Jamey Henry at 018 299 2266 or Ethics-HRECProcess@nwu.ac.za if you have any concerns that were not answered about the research or if you have complaints about the research.

- This study is funded by a bursary for the North-West University.

- You will receive a copy of this information and consent form for your own purposes.

- As there is only limited space available in this study, the first 180 consumers that have met the inclusion criteria will be able to take part in the study.

Declaration by respondents (via electronically agreeing)

Please go back to the informed consent part in the questionnaire to agree to the following statements below. They are provided in the questionnaire again for your convenience. By selecting “I agree” in the questionnaire, you agree to take part in the research study titled: Development of emotion lexicons for consumers’ taster status to describe sugar-free chocolate

I agree that:

- I have read this information in a language with which I am fluent and comfortable.
- The research was clearly explained to me in the informed consent form, and I understand the information I have read.
- I have had a chance to contact the researcher to ask questions.
- I understand that taking part in this study is **voluntary,** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be affected in a negative way if I do so.

Please click on “I agree” in the electronic tab where the questionnaire is if you agree to the terms stated above.

Addendum B: Poster to advertise the study

CHOCOLATE TASTING STUDY

TASTING OF SUGAR-FREE CHOCOLATE

Do you consume chocolate at least once a year?

Are you above the age of 18?

Do you want to be a part of an exciting research study focusing on consumer taster status and sugar-free chocolates?

If you are interested, please click on the link (in the description) to find out how you can be a part of this study.

If you qualify to take part in our study,
you will have to collect your two sugar-free chocolate bars
at a coffee shop in Potchefstroom from
19 to 22 January 2021 (09h00 to 16h00) or
23 January 2021 (09h00 to 13h00)

The tasting of the chocolate should take place within 72 hours of collection at a time and place that is most convenient to you such as your home or work place.

Any questions, please contact the researcher at

chocolatetastingstudy@gmail.com

Addendum C: Screening questionnaire

What is your age?	
Under 18 years of age	END
Above 18 years of age	CONTINUE
Do you understand the English language well?	
No	END
Yes	CONTINUE
Do you have basic computer knowledge?	
No	END
Yes	CONTINUE
Did you consume chocolate at least once in the past year?	
No	END
Yes	CONTINUE
Do you enjoy eating chocolate?	
No	END
Yes	CONTINUE
Do you have any allergies or are sensitive to any of the following ingredients?	
• Cocoa butter • Full milk powder • Alimentary fibre (dextrin, inulin, oligofructose) • Cocoa mass • Whey powder • Hazelnuts (10%) • Sweeteners (erythritol, steviol glycosides) • Emulsifier: soya lecithin • Vanilla • Roasted cocoa bean kernels (7%) • Allergens e.g. Soy, tree nuts, cow's milk	
Yes	END (refer to ingredient list attached if allergic or sensitive to any ingredient survey will end)
No	CONTINUE
Do you have any specific dietary requirements? (Such as banting, vegan, low Gi, etc.)	
Yes	END
No	CONTINUE
Are you currently on any medication?	
Yes	END
No	CONTINUE
Are you suffering from any oral diseases or gum diseases?	
Yes	END
No	CONTINUE
Are you currently, or suspect that you may be pregnant?	
Yes	END
No	CONTINUE
Do you have in-depth knowledge or education related to chocolates and consumer taster tastes	
Yes	END
No	CONTINUE
Will you be able to collect your two sugar-free chocolate bars at a coffee shop in Potchefstroom from 19 to 22 January 2021 (09h00 to 16h00) or 23 January 2021 (09h00 to 13h00)?	
Yes	CONTINUE
No	END
Not sure	END

Addendum D: E-mail after being successfully screened

CHOCOLATE TASTING STUDY

From: chocolatetastingstudy@gmail.com
To: Respondent

Good day,

Thank you for your interest in this study. You meet the inclusion criteria and can therefore continue with the study.

Here is the time and location where you can collect your sample bag that you will use when completing the main questionnaire.

Time of collection: 19 January 2021 Tuesday to 22 January 2021 Friday (09h00 to 16h00) and 23 January 2021 Saturday (09h00 to 13h00).

Location: Black Orchid Boutique venue - 91 A Dr James Moroka Street, 2531 Potchefstroom, South Africa

Due to the COVID-19 pandemic please remember to wear your face mask when entering the central location for collection of the sample bag. An alcohol-based sanitizer will be present at the entrance of the central location. Only one person will be allowed at a time at the table in the central location to collected a sample bag, this is to ensure social distancing. Please note that participation in this study is voluntary and you can withdraw from the study without any consequences.

If you have any questions, concerns, or comments, please feel free to contact me at: chocolatetastingstudy@gmail.com You can also contact the NWU-Health Research Ethics Committee via Mrs Jamey Henry at 018 299 2266 or Ethics-HRECProcess@nwu.ac.za if you have any concerns that were not answered about the research or if you have complaints about the research.

Kind regards

xxxx

Addendum E: One week before the tasting of chocolates take place (reminder 1)

CHOCOLATE TASTING STUDY

From: chocolatetastingstudy@gmail.com
To: Respondent

Good day ,

Hope that this e-mail finds you well. This e-mail is just to remind you of the chocolate tasting study taking place in one week (19 January 2021). For your convenience here is the time of collection with the location.

Time of collection: 19 January 2021 Tuesday to 22 January 2021 Friday (09h00 to 16h00) and 23 January 2021 Saturday (09h00 to 13h00).
Location: Black Orchid Boutique venue - 91 A Dr James Moroka Street, 2531 Potchefstroom, South Africa

Please click on the provided link below to access the informed consent form that you agreed to in the screening questionnaire. Please read through the informed consent form to familiarize yourself with the information.
https://drive.google.com/file/d/1qBJX2Q1WH07PFb3Oh6nfvTMl0Ci-z-e3/view?usp=sharing

If you have any questions, concerns, or comments, please feel free to contact me at: chocolatetastingstudy@gmail.com You can also contact the NWU-Health Research Ethics Committee via Mrs Jamey Henry at 018 299 2266 or Ethics-HRECProcess@nwu.ac.za if you have any concerns that were not answered about the research or if you have complaints about the research.

Kind regards
xxxx

Addendum F: One day before the tasting of chocolates take place (reminder 2)

CHOCOLATE TASTING STUDY

From: chocolatetastingstudy@gmail.com

To: Respondent

Good day,

Collection of the chocolate samples will start tomorrow (19 January 2021). The research assistant will be available at the central location for a short briefing when collecting the samples.

Please remember to wear your face mask. Hand sanitizer will be available at the door.

Here is the time of collection and a link to the location of the building where the chocolate samples can be collected.

Time of collection: Tuesday to Friday (09h00 to 16h00) and Saturday (09h00 to 13h00).

Location: Black Orchid Boutique venue - 91 A Dr James Moroka Street, 2531 Potchefstroom, South Africa

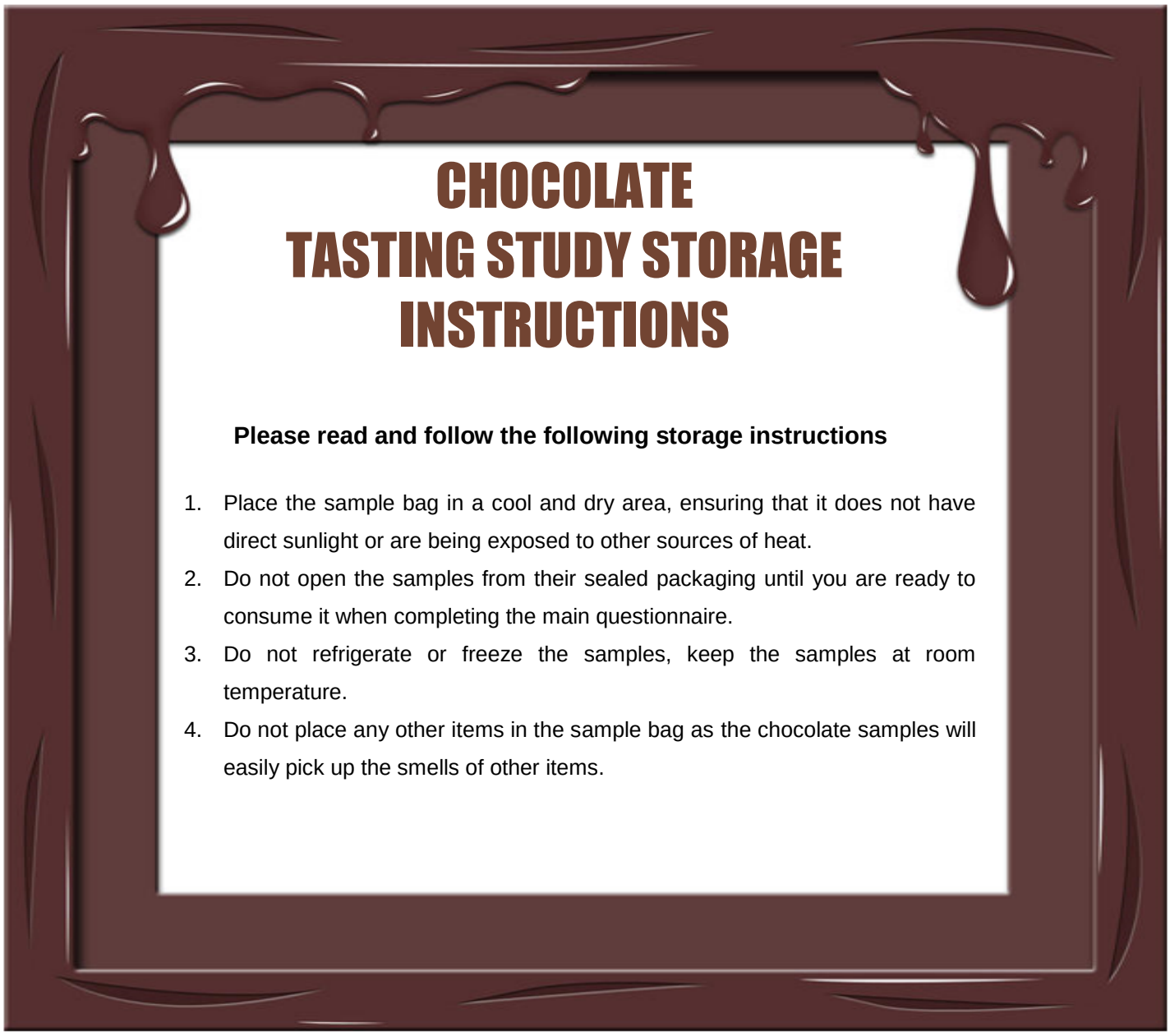
https://goo.gl/maps/PazUt3EBRuwmHTg59

Excited to see you there.

Kind regards

xxxx

Addendum G: Storage instructions



Addendum H: Questionnaire instructions

CHOCOLATE TASTING STUDY

Instructions for home testing

Important information

Please read and follow the following instructions for home testing

Please make sure you have 15-20 minutes to complete the questionnaire. You can start the questionnaire at any time that is most convenient for you, but as soon as you start you will have to complete the questionnaire in one sitting.

You do not have to consume all the chocolate samples to complete the questionnaire– more chocolate samples are provided than what you need. Also please note that this questionnaire consists out of five sections and you will only start to taste the chocolate samples at section three. Please note that the chocolate samples are marked at sample 1 or sample 2, ensure that you match the correct sample to the questions when completing the questionnaire.

You will have to answer all the questions in one section before the questionnaire will let you go to the next section. Please ensure that you clean your pallet by drinking from the bottle water before tasting any of the samples (even before the first sample). Please ensure that you fill in your e-mail address at the end of the questionnaire, using the same e-mail address you used in the screening questionnaire.

When the study is completed you will receive a summary of the results on the same platform that the study was advertised (Facebook® and Instagram). Please contact the research assistant if you have any questions before, during or after the questionnaire. The research assistant contact details are on the e-mail that was send to you and can also be found at the bottom of the pamphlet.

If you have any questions, concerns, or comments, please feel free to contact me at: chocolatetastingstudy@gmail.com

CHOCOLATE TASTING STUDY
Instructions for home testing

Here are the steps you have to follow for completing the questionnaire:

Step 1: Start by laying out the impregnated paper disks, chocolate samples, bottle water and this pamphlet with instructions in arms reach.

Step 2: Open the electronic questionnaire by accessing the link that was send to you via e-mail. You can start the questionnaire and read through the informed consent. If you agree with the informed consent, click on the ‘’I agree” option and the questionnaire will begin.

Section A

Step 3: Please start section A of the questionnaire by testing your bitterness level putting an impregnated paper on your tongue and determine to what extent you find the paper to be bitter. Please rate the intensity of the bitterness on the labelled magnitude scale (LMS) from 1 to 100 where 1 is ‘‘barely detectable’’ and 100 is ‘‘strongest imaginable’’. Please take a three-minute break and clean your pallet using the water and repeat the process. You have to do this three times. After you finished this process please clean your pallet using the water.

Section B

Step 4: Please start with section B of the questionnaire and answer the questions. When you answered the questions in section B please place the chocolate samples in front of you and make sure you can clearly see what chocolate is sample 1 and sample 2.

CHOCOLATE TASTING STUDY
Instructions for home testing

Section C

Step 5: Please start with section C of the questionnaire. Please take your first medium size bite from the chocolate sample 1 and indicate how you feel about the taste and after taste of the chocolate and how likely you are to purchase the product. After you have answered the questions for chocolate sample 1, please clean your pallet with the water and repeat this step for chocolate sample 2. When you completed the questions for section C please clean your pallet with the bottle water.

Section D

Step 6: Please start with section D of the questionnaire. Please take your second medium size bite from the chocolate sample 1. Please indicate all the emotional terms they are feeling while consuming the first chocolate sample. The next question will then ask you to indicate any other emotional terms you felt while consuming chocolate sample one and if there is any further comments that you have about chocolate sample one. Please clean your pallet with the water and repeat this step for chocolate sample 2.

Section E

Step 7: Please start with section E of the questionnaire. Please answer all the questions about your demographical information.

Thank you for your time and effort to complete the questionnaire.

If you have any questions, concerns, or comments, please feel free to contact me at: chocolatetastingstudy@gmail.com

Addendum I: E-mail to respondents with link to survey

CHOCOLATE TASTING STUDY

From: chocolatetastingstudy@gmail.com

To: Respondent

Good day,

By now you should have collected your sample bag from the central location in Potchefstroom. Please ensure that you follow the storage instructions that are in the sample bag until you start with the questionnaire. Please follow the link below to access the electronic questionnaire. Please remember:

1. You have to complete the questionnaire in one sitting, you can complete the questionnaire at a time that is most convenient to you, but it is recommend that you do the questionnaire at a time and location you would usually consume chocolate. Please complete the questionnaire within 72 hours after collection.
2. Please follow the instructions in the sample bag, as it will explain what to do in each section of the questionnaire and make sure that you are tasting the correct sample as indicated on the chocolate samples and on the questionnaire. It is extremely important that you do not deviate from the instructions.
3. Please complete the survey by yourself, without help or the opinions of others.

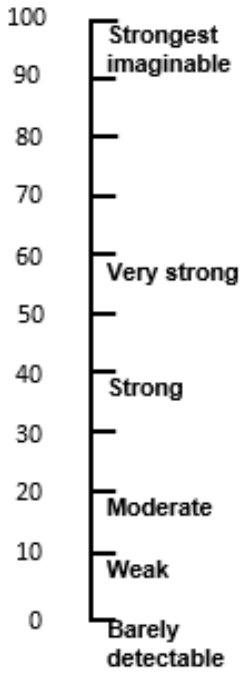
https://www.questionpro.com/t/AQw1nZjixT

If you have any questions, concerns, or comments, please feel free to contact me at: chocolatetastingstudy@gmail.com You can also contact the NWU-Health Research Ethics Committee via Mrs Jamey Henry at 018 299 2266 or Ethics-HRECProcess@nwu.ac.za if you have any concerns that were not answered about the research or if you have complaints about the research.

Kind regards

Addendum J: Main questionnaire section A – Taster status test

1. You are provided with **three (3) paper disks** in a small plastic bag and a **bottle of still water.** Please make sure your **hands are clean**.
2. Please **rinse your mouth** with the **water before** you start to evaluate the paper disks.
3. Please **place one of the paper disks** on the **tip of your tongue** for 30 seconds or until the paper disk is wet with saliva and then remove it from your mouth.
4. Please indicate **how intense is the bitterness** of the paper disk **by dragging the bar** on the labelled scale provided below that **best describes the intensity of bitterness.**
5. You may use **any part of the line** that you feel is appropriate.
6. The scale is from **1 that is barely detectable to 100 which is the strongest imaginable.**
7. Please give yourself a **3-minute break** and use the **water to clean your mouth**.
8. **You have to do this three (3) times**.



Addendum K: Main questionnaire section B – Taster status

Please indicate **how you feel** about the following **food products** by selecting the appropriate box using a **scale from 1 to 5,** where **1 indicates an extreme dislike**, **and 5 indicates an extreme like**.					
	Dislike extremely	**Dislike very much**	**Neither like nor dislike**	**Like very much**	**Like extremely**
Broccoli	1	2	3	4	5
Brussels sprouts	1	2	3	4	5
Cabbage	1	2	3	4	5
Asparagus	1	2	3	4	5
Spinach	1	2	3	4	5
Grapefruit/ Pumelo	1	2	3	4	5
Tonic water	1	2	3	4	5
Black coffee (without sugar)	1	2	3	4	5
Dark chocolate	1	2	3	4	5
Grapefruit juice	1	2	3	4	5
Green tea (without sugar)	1	2	3	4	5
Legumes (for example: black-eyed peas, chickpeas, beans)	1	2	3	4	5
Beer	1	2	3	4	5
Nuts	1	2	3	4	5

Addendum L: Main questionnaire section C – Chocolate consumption

QUESTION 1

Please think about your chocolate consumption in your everyday life and answer the questions below by selecting the most applicable option (Only choose one option).				
How often do you eat chocolate?				
Daily	More than twice a week	Twice a week	Once a week	Once a month or less
What is your main reason for eating chocolate?				
For emotional satisfaction (indulgence)	To overcome hunger	Consider it healthy	As a habit	Other reason (specify)
What is your main consideration when purchasing chocolate for your own consumption?				
Brand	Flavour	Price	Packaging	Other reason (specify)

QUESTION 2

Sample 1

Please rinse your mouth with the water and then place the first chocolate sample in front of you named Sample 1. Please make sure your hands are clean.

1. You have received **two (2) chocolate samples**.
2. Please take your **first medium size bite** from the **first chocolate sample (sample 1).**
3. **Please do not consume all the chocolate samples at once.**
4. Please indicate how you **experience the taste and aftertaste** of the chocolate by selecting the appropriate box using a scale from **1 to 5, where 1 is dislike extremely and 5 is like extremely.**

	Dislike extremely	**Dislike very much**	**Neither like nor dislike**	**Like very much**	**Like extremely**
Taste	1	2	3	4	5
After taste	1	2	3	4	5

Please indicate if you would purchase this product.

	Definitely would not buy	**Probably would not buy**	**Might or might not buy**	**Probably would buy**	**Definitely would buy**
Chocolate sample 1	1	2	3	4	5

Sample 2

Please rinse your mouth with the water and then place the second chocolate sample in front of you named Sample 2. Please make sure your hands are clean.

1. Please take your **first medium size bite** from the **second chocolate sample (sample 2).**
2. **Please do not consume all the chocolate samples at once.**
3. Please indicate how you **experience the taste and aftertaste** of the chocolate by selecting the appropriate box using a scale from **1 to 5, where 1 is dislike extremely and 5 is like extremely.**

	Dislike extremely	**Dislike very much**	**Neither like nor dislike**	**Like very much**	**Like extremely**
Taste	1	2	3	4	5
After taste	1	2	3	4	5

Please indicate if you would purchase this product.

	Definitely would not buy	**Probably would not buy**	**Might or might not buy**	**Probably would buy**	**Definitely would buy**
Chocolate sample 2	1	2	3	4	5

Addendum M: Main questionnaire section D – Emotional response

QUESTION 1

Sample 1

Please rinse your mouth with the water and then place the first chocolate sample in front of you named Sample 1. Please make sure your hands are clean.

1. The following questions need to be **answered** while you are **tasting the chocolate**.
2. Please take your **second medium-size bite** from the **first chocolate sample (sample 1)**.
3. Please select **all the emotional terms** that best describe what you are **feeling when consuming** the chocolate. **You can choose more than one term.**

D1

- ☐ Calm
- ☐ Contented
- ☐ Desire
- ☐ Disappointed
- ☐ Discontented
- ☐ Disgust
- ☐ Dissatisfied
- ☐ Enthusiastic
- ☐ Glad
- ☐ Good
- ☐ Guilty
- ☐ Happy
- ☐ Nervous
- ☐ Pleasant
- ☐ Sad
- ☐ Satisfied
- ☐ Unpleasant Surprise

Are there **any emotional terms** not included that you **felt while consuming** the chocolate? Please **type your answers** out.

Do you have **any further comments** on **chocolate sample 1** that you would like to share with us:

Sample 2

Please rinse your mouth with the water and then place the second chocolate sample in front of you named Sample 2. Please make sure your hands are clean.

1. The following questions need to be **answered** while you are **tasting the chocolate**.
2. Please take your **second medium-size bite** from the **second chocolate sample (sample 2)**.
3. Please select **all the emotional terms** that best describe what you are **feeling when consuming** the chocolate. **You can choose more than one term.**

☐	Calm	☐	Good
☐	Contented	☐	Guilty
☐	Desire	☐	Happy
☐	Disappointed	☐	Nervous
☐	Discontented	☐	Pleasant
☐	Disgust	☐	Sad
☐	Dissatisfied	☐	Satisfied
☐	Enthusiastic	☐	Unpleasant Surprise
☐	Glad		

Are there **any emotional terms** not included that **you felt while consuming** the chocolate? Please **type your answers** out.

Do you have any further comments on chocolate sample 2 that you would like to share with us:

Addendum N: Main questionnaire section E – Demographic information

Please answer the questions below by selecting the applicable option:	
What is your gender?	
Male	
Female	
Other	
What is your age?	
18-29 years	
30-39 years	
40-49 years	
50-59 years	
60 years and older	
Prefer not to say	
In which province is your hometown located?	
Eastern Cape	
Free State	
Gauteng	
KwaZulu-Natal	
Limpopo	
Mpumalanga	
Northern Cape	
North West	
Western Cape	
Where did you complete the questionnaire?	
At home	
At the venue where the samples were collected	
Other (please specify)	

Addendum O: Ingredient list

- Cocoa butter
- Full milk powder
- Alimentary fibre (dextrin, inulin, oligofructose)
- Cocoa mass
- Whey powder
- Hazelnuts (10%)
- Sweeteners (erythritol, steviol glycosides)
- Emulsifier: soya lecithin
- Vanilla
- Roasted cocoa bean kernels (7%)

- Milk chocolate contains cocoa solids 36% minimum
- Milk solids 30 % minimum
- Dark chocolate contains cocoa solids 80% minimum

Allergens

- Soya
- Tree nuts
- Cow’s milk

*Please note that this list is for illustrative purposes only.

Addendum P: Open ended question: Emotional terms describing respondents' chocolate tasting

Milk Chocolate (Sample 1)		**Dark Chocolate (Sample 2)**	
Positive emotions	"Chilled"	Positive emotions	"Strong"
	"Peaceful"		"Nostalgic"
	"Relief"		"Relaxed"
	"Happy"		"Love"
	"Cosy"		"Warm and loved"
	"Safe and loved"		"Happy"
	"Warm"		"Joy"
	"Gentle"		"Love love"
	"Generous"		"Pleasant surprise"
	"Fulfilled "		"Makes me feel 'dreamy'...."
			"I would describe it as a good holiday?"
			"Feeling completed "
			"Fulfilled"
Excitement	"Energetic, nostalgic, young"	Excitement & surprise	"Adventurous, energized, awake"
	"Joy"		"Excitement"
	"Excited, to experience the taste"		"Surprised"
			"Pleasantly surprised"
			"Surprise"
			"Pleasant surprise"
Positive taste experience	"Smooth"	Positive taste experience	"Had a more intense flavour the second time and also liked the crunchiness."
	"Nice and soft on pellet"		"enjoy sample 2 more than sample one"
	"Sweet"		

	“Indulged”		
Negative taste experience	“Irritated by the aftertaste”	Negative taste experience	“Did not like. Unhappy”
	“Bored”		“Do not like the bitterness of the chocolate. Prefer milk chocolate. Will not buy it for myself as I like creamy sweet chocolates. I do like the 'crunch' “
	“Nonchalant”		“Strong aftermath”
Uncertainty	“I experienced mix feelings when consuming this chocolate. “	Uncertainty	“Mysterious “
	“Confused, nostalgic”		“Neutral in a sense, it's not as bitter as most dark chocolates I've tried”
	“Not liking the taste at first but after it starts melting in my mouth it tastes much better.”		“Neutral”
			“Uncertain”
		Curiosity	“Interested”
			“Inquisitive”
		Luxury	“inadequate, all the chefs always say use a good dark chocolate, I do not like the taste or after taste, when I taste this it feels as if I am supposed to like it but that I lack the sophistication”
			“Fancy. I felt fancy. As dark chocolate is fancier, like instead of Rosé, a Merlot. Different tastes apply to different people, but people always say, you only really like chocolate, if you like dark chocolate.”
			“Powerful, Wealthy, Witty, Superior”
			“Accomplished”
			“Extravagant & fancy”

			“Fancy”
		Health related	“Healthy”
			“Care”

Addendum Q: Open ended question: Respondents' comments on chocolate samples

Milk Chocolate (Sample 1)		**Dark Chocolate (Sample 2)**	
Sensory properties	"Very smooth"	Sensory properties	"Crunchy as well"
	"Was soft"		
	"The texture is appealing but the taste is disappointing. Could be more sweet"		"Texture not as smooth and milky as sample 1, with some crunchy bits in that gave a bitter after taste"
	"Its initial taste is nice but I feel it could be creamier and maybe a bit sweeter. The aftertaste is quite bitter considering it's the milk and not dark chocolate. It does have that melt in the mouth feel like other quality chocolate"		"There were little crunchy... bits, small, but there - I like the little texture, the after taste is really not nice, it lingers"
			"There were little crunchy... bits, small, but there - I like the little texture, the after taste is really not nice, it lingers"
	"It's a good chocolate, very soft. Tastes like the chocolates you would get during Christmas which makes me feel very nostalgic. The chocolate has a grainy taste when hitting the tongue first then melts into a smooth consistency when warm. The after taste lasts a while, which is not a very chocolatey taste but isn't bad"		"Texture not as smooth and milky as sample 1, with some crunchy bits in that gave a bitter after taste"
			"Does not melt in mouth. Hard bits inside not nice."
			"Love the crunch in sample 2"
			"Love the texture of the chocolate"
			"Love the crunchy bits - nuts maybe? It's a very 'soft'/subtle dark chocolate taste (in a good way)."
	"Melts in the mouth easily. Its creamy"		
			"I like the bits in between"
	"Super smooth"		"The crunch in the center is enjoyable"
	Sample 1 is creamy and soft textured.		
	"Love the soft consistency"		"Ditto on the crunchy bits."
	"I really enjoyed the smell as well. It was calming"		"The chocolate was a little bland."

	“To me sample 1 has a peculiar nutty flavour which makes the overall taste richer and fuller, whilst not compromising the pleasant aftertaste. Unlike a common Cadbury slab that has a very momentary pleasure to it, sample 1 allows you to savour the chocolate before you want the next bite.”		“It's more crunchy than sample 1, making me think of nuts (although don't specifically taste nuts). It's not as smooth - sample 1 melt easily in my mouth whereas sample 2 requires more 'chewing'.”
			“Love the bold flavours”
			“Great texture”
			“Like the bits in the chocolate”
	“Didn’t expect the change in flavor the second time, was pleasantly surprised. Love the texture”		“It taste more dreamy than the first sample Love dat dit 'n 'crunchy' texture het.”
	“I love the smooth texture of the chocolate (it's more milky than sample 2). It melts in my mouth... “		“This will be my favourite, spicy, bitter but pleasing taste stays with you for some time”
	“The texture is quite pleasant as well”		“Great texture, also not too sweet, and delicious!”
	“It doesn't have a creamy chocolate taste that other chocolates have”		“I like the different textures and crunchy biys in the chocolate and the taste is bitter but I love it!”
	“It is not smooth and creamy”		“Dit is wel bietjie klein, dit is n vreemde tekstuur. Ek verkies groter stukke.”
	“I like the chocolate; it's not overly sweet even though I might only be able to eat a medium piece every now and then. I like the smoothness of the chocolate, and it tastes much better than Cadbury or Beacon slabs”		“Again, the texture. Prefer a smooth textured chocolate.”
			“It's absolutely rich with flavor and it seems like there's cocoa bits in the chocolate. I love it! The taste while eating and aftertaste is wonderful.”
	“Creamy texture, very good! Not too sweet.”		
	“This chocolate is very soft and I felt relaxed after eating it.”		
	“Its very dense and I wont be able to eat a lot of it.”		

	“Very bland taste after tasting sample 2. Almost like a plastic taste while eating it”		
	“The after taste is quite oily for me and I do not like oily foods.”		
Taste and after taste	“It tastes very good”	Taste and after taste	“It has a dark chocolate taste and really like the nuts inside”
	“A very nice and balanced taste”		“It has a awful after taste for dark chocolate.”
	“Initial taste is disappointing, but as it melts it improves”		“Initial taste is offputting but gets better with time”
	“Tastes very plastic and bad aftertaste”		“I feel this chocolate has the potential to be great. I don't have much of a sweet tooth but this did not satisfy my craving. The aftertaste is not as bitter, which is good”
	“Overall good but not great, slight metallic after taste that I find unpleasant.”		
	“Very nice chocolate. I enjoy that it is not that sweet. I usually have a big sweet tooth, but this is just right”		“Because it is a richer chocolate, with more cocoa, I am satisfied after fewer blocks. Less sweet than sample 1. Consistency with the little chuncks is a good touch”
	“I taste very nice”		“it tasted if there were charcoal in it”
	“Does not have strong chocolate taste”		“This is to bitter for my taste, but I don’t like dark chocolate. It is to bitter for my taste.”
	“The chocolate is a bit bland, it feels as if something is 'missing' from the recipe. There remains a 'flat' aftertaste.”		“The initial taste of sample 2 not very forthcoming, however the smoothness paired with the nibs is a lovely surprise and it really delivers on the aftertaste.”
	“The chocolate is a little bland and do not have a overwhelming chocolate taste”		“When compared to most darker chocolate I purchase, this one held up well. I tend to taste the sweetness of dark chocolate first, and then only the bitterness. Here the experience was more cohesive and enjoyable. For example: with a Bourneville chocolate I usually taste the two tastes separately (sweet and
	“i like the taste. there is no funny aftertaste and it leaves me wanting another bite. very tasty”		
	“A little bit tasteless in the beginning and not so sweet. Have to eat a few before it gets sweet.”		

			bitter) and with a Lindt/dark kit kat it all combines into one cohesive and pleasant taste.”
	“Definitely sweet enough, very good”		“The sample had a lot of cocoa powder. It was hard. The bits in it tasted like soil. It was extremely bitter”
	“Tastes like cheap baking chocolate”		“I enjoy the stronger taste of sample 2 much more than the one of sample 1”
	“It didn't taste like much. Reminded me of cheap china made choc. Lol...”		“Very tasty chocolate tastes more like a Lindt”
	“I like the bitterness of the chocolate, it is also more creamy with a pleasant after taste”		“Can taste and see it is a dark chocolate meaning you caj taste the cacao”
	“Sample 1 has a weird taste, more like it's missing an ingredient.”		
	“Lingering milky aftertaste, would not recommend”		
	“It has an oily taste”		
	“Tates rubbery”		
	“i do like a more creamy feel on my tongue. After taste not as satisfactory and content as i am use to.”		
	“It leaves a plasticity feel on my palate afterwards...”		
Suggestions	“It would go brilliantly with a white wine after a long day for relaxing”	Suggestions	“Very good, slight enjoyable coffee note, will pair very well with an Irish Whiskey or a sweeter Bourbon”
	“Would do nicely with something crunchy in it, like cookies ;-P”		“Combine it with a red wine and a cold winter. It is such a nice pallet cleaner”
	“Nice, will prefer mint flavour”		“Could use a bit more nuts”
			“Would go great with roasted almonds”
	Suggestions		Suggestions
Purchase	“I actually like the taste of this chocolate, if it is non-sugar with nuts etc I am sure I would buy it. I do not really eat chocolate but will taste and then buy for others.”	Purchase	“I love dark chocolate. And the little bit of crunch in the chocolate is absolutely WOW!!! Texture is good, taste is amazing. I want to know where can I spend my money on this?”

			“Really liked it. Tasted sweeter then the Sample 1. Will definitely buy it myself.”
			“I would definitely buy and eat it every day.”
Like	“It's great. 10/10”	Like	“I like it more than sample 1”
	“Very good”		“Very nice dark chocolate. Not too bitter.”
	“This is very nice! Not bitter but also not to sweet. Can eat the whole chocolate”		“It's actually the best dark chocolate I have had coz it's not so strong nd I can actually enjoy it”
	“I like the taste!”		“Like bitter chocolate”
	“The chocolate tasted familiar in a way, which made me feel more positive toward it.”		“It is a very nice choclate .. smooth but my first choice would be sample 2”
	“The chocolate tasted familiar in a way, which made me feel more positive toward it.”		“Love it ! The taste is so good and sample 2 is my favourite because I prefer dark chocolate. However, sample 1 was also delicious. Thank you.”
	“It's delicious!”		“Love the nutty taste!!”
	“Very nice product, seems to be of good quality.”		“Definitely a winner”
	“Second, bite better than the first one. More enjoyable!”		“If this is homemade - kudos. It's tasty.”
	It's really nice, it's light nd not to sweet which makes the experience better		“It has a great taste and I like the bits”
	“I will eat it again.”		“I love the bits in the chocolate, it's really tasty”
	“I love this”		“This choclate is my favroute very nice and smooth”
	“I enjoy this product very much.”		“I like the pieces in the chocolate.”
	“Amazing taste. Love it!”		“Baie lekker, alhoewel ek neem aan daar is neute in die chocolate.”
	“It was very good.”		“Really good chocolate, but not a fan of the cacao nibs”
	“Very good!!!”		“I like sample 2 more than sample 1. The bits inside the chocolate was a surprise”
			“It has character”

			“I like the bits in the chocolate.”
			“Very good!”
		Dislike	“I am not a fan of cocoa that has a bitter taste. I don't like dark chocolate and maybe it is a mental thing.”
			“The hard pieces is not nice, can not figure out if should be there”
		Cravings	“I like this chocolate; it is not as bitter as Lindt Dark Chocolate and ia small bite would satisfy a chocolate craving if I had one; I would feel satisfied that I'm eating healthy dark chocolate (if I knew for certain that this were made from real cacao beans) but I would enjoy the experience more as well, because it is not overly bitter. This chocolate I also find more physically satisfying than Sample 1 - a little taste would go a longer way until the next time I crave chocolate.”
			“Sample 2 has a completely different texture and I am not just referring to the crunchy bit which is actually very nice. I feel less likely to overindulge on Sample 2, it feels like my chocolate craving is more satisfied with sample 2.”

Addendum R: Statistical analysis for emotional terms for all tasters

	Phi / Cramer's V			
	Value	Sig.	Value	Sig.
	Sample		Sample	
	1		2	
Calm	0.096	0.486	0.045	0.854
Contented	0.222	0.020*	0.063	0.730
Desire	0.113	0.365	0.062	0.735
Disappointed	0.052	0.809	0.109	0.388
Discontented	0.145	0.190	0.233	0.014*
Disgust	0.085	0.569	0.160	0.132
Dissatisfied	0.055	0.787	0.116	0.347
Enthusiastic	0.114	0.358	0.104	0.423
Glad	0.058	0.765	0.129	0.269
Good	0.018	0.976	0.132	0.251
Guilty	0.219	0.023*	0.145	0.188
Happy	0.081	0.597	0.143	0.197
Nervous	x	X	0.143	0.198
Pleasant	0.130	0.263	0.102	0.442
Sad	0.139	0.216	0.040	0.881
Satisfied	0.140	0.211	0.071	0.673
Unpleasant surprise	0.092	0.511	0.110	0.382

Notes: 1 = Sample 1 (sugar-free milk chocolate), 2 = Sample 2 (sugar-free dark chocolate); Phi value indicates the effect sizes: ~0,1 practically non-significant association, ~0.3 practical visible significance, ~0,5 practically significant. *Significance indicates the p-value: p <0,05 indicates that there is a statistically significant association. P-values are reported for completeness' sake but will not be interpreted, as an availability sample instead of a random sample was used.

Addendum S: Ethics approval

Private Bag X1290, Potchefstroom
South Africa 2520

Tel: 086 016 9698
Web: http://www.nwu.ac.za/

North-West University Health Research Ethics Committee (NWU-HREC)

Tel: 018 299-1206
Email: Ethics-HRECApply@nwu.ac.za (for human studies)

3 December 2020

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the North-West University Health Research Ethics Committee (NWU-HREC) on 03/12/2020, the NWU-HREC hereby approves your study as indicated below. This implies that the NWU-HREC grants its permission that, provided the general conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Development of emotion lexicons for consumers' taster status to describe sugar-free chocolate
Principal Investigator/Study Supervisor/Researcher: Prof A Mielmann
Student: T van Zyl - 27308936

Ethics number:

N	W	U	-	0	0	4	9	0	-	2	0	-	A	1
Institution				Study Number						Year			Status	

Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application Type: Single study
Commencement date: 03/12/2020
Expiry date: 28/02/2022

Risk: **Minimal**

Approval of the study is provided for a year, after which continuation of the study is dependent on receipt and review of an annual monitoring report and the concomitant issuing of a letter of continuation. A monitoring report is due at the end of February annually until completion.

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- *The principal investigator/study supervisor/researcher must report in the prescribed format to the NWU-HREC:*
  - *Annually on the monitoring of the study, whereby a letter of continuation will be provided annually, and upon completion of the study; and*
  - *without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.*
- *The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the principal investigator/study supervisor/researcher must apply for approval of these amendments at the NWU-HREC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.*
- *Annually a number of studies may be randomly selected for active monitoring.*
- *The date of approval indicates the first date that the study may be started.*
- *In the interest of ethical responsibility, the NWU-HREC reserves the right to:*
  - *request access to any information or data at any time during the course or after completion of the study;*
  - *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;*

- *withdraw or postpone approval if:*
  - *any unethical principles or practices of the study are revealed or suspected;*
  - *it becomes apparent that any relevant information was withheld from the NWU-HREC or that information has been false or misrepresented;*
  - *submission of the annual monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and/or*
  - *new institutional rules, national legislation or international conventions deem it necessary.*
- *NWU-HREC can be contacted for further information via Ethics-HRECApply@nwu.ac.za or 018 299 1206*

Special conditions of the research approval due to the COVID-19 pandemic:

Please note: Due to the nature of the study i.e. (online collection of quantitative data in response to chocolate samples that will be collected from a central point within Potchefstroom), this study will be able to proceed during the current alert level, following receipt of the approval letter. No additional COVID-19 restrictions have been placed on the study other than those that are indicated in the COVID-19 risk mitigation strategy as indicated in the application. Please ensure, that before proceeding with the study, that all research team members have reviewed the North-West University COVID-19 Occupational Health and Safety Standard Operating Procedure.

The NWU-HREC would like to remain at your service and wishes you well with your study. Please do not hesitate to contact the NWU-HREC for any further enquiries or requests for assistance.

Yours sincerely,

Digitally signed by
Prof Petra Bester
Date: 2020.12.03
13:33:34 +02'00'

Chairperson NWU-HREC

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20 August 2019
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Addendum T: Proof of editing

PROOF OF EDITING

Dr. L. Hoffman, APEd (SATI), APRed (SAVI)

Kroonstad

BA, BA(Hons), MA, DLitt et Phil

Accredited Professional Text Editor – English and Afrikaans (South African Translators' Institute)

Member of the South African Translators' Institute

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DECLARATION

To whom it may concern

I hereby confirm that I have proofread and edited the following dissertation:

Title of dissertation

Development of emotion lexicons to describe sugar-free chocolate according to consumers' taster status

Candidate

Telana van Zyl

Lariza Hoffman
Kroonstad
6 August 2021

Addendum U: TurnItIn report

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