

# Consumers' attitudes regarding the link between frozen and fresh vegetables and health

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## Authors' contributions

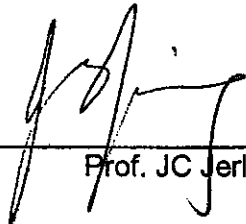
The contribution of each of the researchers involved in this study is given in the following table:

<u>Name</u>	<u>Role in the study</u>
EM van der Walt M.Sc (Dietetics) candidate	Responsible for literature searches, processing of data, statistical analysis, interpretation of results and writing of manuscript.
CS Venter D.Sc (Nutritionist/Dietitian)	Supervisor. Supervised the writing of the manuscript.
JC Jerling Ph.D (Nutritionist)	Co-supervisor. Supervised the statistical analysis.

The following is a statement from the co-authors confirming their individual role in the study and giving their permission that the article may form part of this mini-dissertation.

*I declare that I have approved the above-mentioned article, that my role in the study, as indicated above, is representative of my actual contribution and that I hereby give my consent that it may be published as part of the M.Sc mini-dissertation of Emdri van der Walt.*

  
\_\_\_\_\_  
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\_\_\_\_\_  
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## Abstract

Vegetables and fruit appear to confer protection against various diseases, but most adults in South Africa eat substantially less than the recommended amounts. Many barriers and factors that influence vegetable consumption have been identified in the literature. One major barrier is the perishability of vegetables. Frozen vegetables can be a useful way in encouraging greater intakes. Some consumers are, however, of the opinion that processing destroy nutrients to a large extent. There is, therefore, a lack of understanding of the freezing process. Research on the attitudes of consumers towards frozen vegetables in South Africa is limited.

**Objective:** The purpose of this study was to determine the attitudes of consumers regarding the link between frozen and fresh vegetables and health and the attributes of frozen vegetables.

**Subjects/Setting:** One thousand nine hundred and ninety seven South African respondents, representative of the four major race groups of South Africa (whites, blacks, coloureds and Indians) were randomly chosen from metropolitan areas from the nine provinces in South Africa. Questionnaires, existing of 17 food-related sections, including subsections on vegetables and health, were designed by researchers in co-operation with business partners. MARKINOR, a market research company, was contracted to collect the data. Respondents were questioned regarding their attitudes towards the link between frozen and fresh vegetables and health.

**Statistical analysis performed:** The quantitative data produced by the survey was analysed by using the Statistica®-programme in order to generate the relevant tabulations, descriptive statistics and statistical tests.

**Results:** Overall, the attitudes of consumers towards frozen vegetables were found to be negative. Practical and statistically significant attitude differences towards frozen vegetables were found between most variables. Results from this study revealed that different levels of education, age and gender do not have a big influence on consumer's attitudes towards frozen vegetables. However, practical and statistically significant differences were found between the various LSM (Living Standards Measure) groups, especially with regard to the convenience of frozen vegetables. Results also indicated that Indians, the age group 61+ and males were the most negative towards frozen vegetables. Almost 75% of all consumers indicated that they never eat frozen vegetables. Only 1% of consumers in the LSM group 2 own a fridge/freezer. An alarmingly 26% of all consumers indicated that they are not convinced that vegetables are healthy.

**Application/Conclusions:** Nutrition professionals should use these findings to target messages in health-promotion programmes to increase the overall consumption of vegetables. The use of frozen vegetables by consumers with frozen storage facilities should be promoted aggressively. Consumers also need practical advice on how to overcome the barriers to dietary change. Nutrition counseling efforts should also be aimed specifically at increasing frozen vegetable consumption among targeted subgroups, particularly Indians, males and the age group 61+. It is strongly recommended that suitable measuring instruments be developed for assessing the knowledge and attitude of South Africans

towards vegetable and fruit consumption and the ability of individuals to improve their health. The results of this study may prove to be very useful in this regard.

## **Uittreksel**

Groente en vrugte speel 'n baie belangrike rol in die voorkoming van verskeie siektes. Daar is gevind dat die inname van groente en vrugte in Suid-Afrika heelwat minder is as die aanbevole daaglikse hoeveelheid. Verskeie redes en struikelblokke word aangevoer waarom voldoende hoeveelhede nie ingeneem word nie. Een groot struikelblok is die bederfbaarheid van groente. Gevriesde groente kan nuttig aangewend word omdat dit lank gestoor kan word en om die rede geredelik beskikbaar is. Uit die literatuur is dit egter duidelik dat verbruikers in ander lande 'n negatiewe houding oor gevriesde groente het. Dit spruit hoofsaaklik uit oningeligtheid oor die bevriesingsproses en ander aspekte van gevriesde groente.

**Doel:** Die doel van hierdie studie was om vas te stel wat verbruikers in Suid-Afrika se houdings ten opsigte van gevriesde teenoor vars groente en gesondheid is.

**Agtergrond:** Eenduisend negehonderd sewe-en-negentig verbruikers uit die nege provinsies in Suid-Afrika, verteenwoordigend van die vier groot rasgroepe in Suid Afrika (wit, swart, kleurlinge en Indiërs) is ewekansig verkies uit stedelike gebiede. Vraelyste, bestaande uit 17 voedselverwante afdelings, insluitende subafdelings oor groente en gesondheid is opgestel deur die navorsers in samewerking met sakevennote. MARKINOR, 'n marknavorsingsmaatskappy is gekontrakteer om die data in te samel. Respondente het vrae geantwoord ten opsigte van hul houdings teenoor gevriesde en vars groente en gesondheid.

**Statistiese analises:** Die kwantitatiewe data wat verkry is, is geanaliseer met behulp van die Statistica® program en sodoende is relevante tabelle, beskrywende statistiek en statistiese toetse ontwikkel.

**Resultate:** Die resultate dui daarop dat verbruikers oor die algemeen baie negatief ingestel is teenoor gevriesde groente. Praktiese en statistiese betekenisvolle houdingsverskille teenoor gevriesde groente is gevind tussen meeste veranderlikes. Resultate het getoon dat verskillende vlakke van opvoeding, ouderdom en geslag nie 'n groot invloed op verbruikers se houdings teenoor gevriesde groente gehad het nie. Daar was egter praktiese en statistiese betekenisvolle verskille gevind tussen die verskeie lewenstandaardgroepe, veral ten opsigte van die gerieflikheid van gevriesde groente.

Daar is onder andere gevind dat die ouderdomsgroep 61+, Indiërs en mans meer negatief teenoor gevriesde groente as ander groepe was. Bykans 75% van alle verbruikers het aangedui dat hulle nooit bevrore groente eet nie. Slegs 1% van die verbruikers in LSM 2 besit 'n yskas/vrieskas. 'n Ontstellende 26% van alle responente het aangedui dat hulle nie oortuig is dat groente gesond is nie.

**Toepassings/Gevolgtrekkings:** Hierdie inligting behoort deur gesondheidswerkers gebruik te word om spesifieke groepe te teiken om sodoende die inname van gevriesde groente en daardeur die totale daaglikse inname van groente te verhoog. Die gebruik van gevriesde groente deur verbruikers wat

vrieskaste het behoort bevorder word. Verbruikers benodig ook praktiese advies om struikelblokke vir dieetverandering te oorkom. Voedingkonsultasie pogings moet ook spesifiek gerig wees om groenteinname te verhoog in spesifieke teikengroepe veral Indiërs, mans en die ouderdomsgroep 61+. Dit word sterk aanbeveel dat geskikte meetinstrumente ontwikkel word vir die bepaling van die kennis en houding van Suid-Afrikaners teenoor die inname van groente en vrugte en die vermoë van individue om hul gesondheid te bevorder. Die resultate van hierdie studie mag in hierdie opsig waardevol blyk te wees.

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## Abbreviations

AFFI	- American Frozen Food Institute
AIDS	- Acquired Immunodeficiency Syndrome
ANOVA	- Analysis of Variance
ASE model	- attitude-social-influence efficacy model
$\beta$	- Beta
CVD	- Cardiovascular Disease
DASH	- Dietary Approaches to Stop Hypertension
DNA	- Deoksiribonucleic Acid
FDA	- Food and Drug Association
g	- gram
LDL	- low density lipoprotein
LSM	- Living Standard Measure
mg	- milligram
NCI	- National Cancer Institute
NTF	- Nutrition Task Force
PBH	- Produce for Better Health Foundation
USA	- United States of America
UK	- United Kingdom
USDA	- United States Department of Agriculture

# Chapter 1: Introduction

## 1.1 Background to the problem

There is a great deal of interest in the association between fruit and vegetable consumption and human health as well as accumulating evidence to support the recommendation to increase the consumption of vegetables and fruit as a means of protection against a number of diseases, particularly cardiovascular diseases and certain forms of cancer (World Health Organization, 1990 in Pollard *et al.*, 2002:373). An intake as a manageable, minimum recommendation of at least five portions (400g) of vegetables and fruits per day has become established by numerous international and national health promotion agencies (USDA, 1997; NTF, 1991; Health and Welfare Canada, 1992; Commonwealth of Australia, 1998; Malaysian Ministry of Health, 1999; Love & Sayed, 2001).

Since vegetables and fruits supply many similar nutrients, their consumption is often tracked as a composite. From the literature it is clear that most consumers are aware that vegetables are healthy, but still inadequate amounts are consumed (Pollard *et al.*, 2002:374). Few studies have investigated vegetable and fruit intakes of South Africans. Overall, intakes of South Africans cannot be regarded as meeting the global recommendations (Love & Sayed, 2001:S24-S32). South Africa is not the only country not achieving the recommended intake of vegetables and fruits. Recent national surveys in the USA estimate mean consumption of vegetables and fruits to be 3.1 – 3.8 servings per day (Love & Sayed, 2001:S24-S32) and in the UK 310 g per day (Ministry of Agriculture, Fisheries and Food, 1999).

The health professional plays a very important role in taking the scientific information and adapting it in such a way that meaningful behaviour change may be achieved by the public. The choices individuals make about foods determine which nutrients are consumed. However, consumers do not choose their foods exclusively for the nutrients they provide. Eating behaviour is complex and understanding the factors that affect food choice are important, given the priority for population dietary change (Pollard *et al.*, 2002:374).

Strategies to increase vegetable consumption should be investigated. The South African Food-Based Dietary Guidelines Consumer Study indicated a number of constraints concerning adequate vegetables and fruit consumption (Love *et al.*, 2001:9-19). They found that among black rural, informal urban and formal urban dwellers, affordability (lack of household income) was the primary constraint. Also, for all groups (black, coloured, Indian and white), fruit consumption was strongly related to availability and highly contingent to seasonal fluctuations. All groups also stated that with regard to taste, most resistance to vegetable and fruit consumption came from the children and, in some cases, the men in the household (Love *et al.*, 2001:9-19).

Researchers reported cost, complacency and family influences as high barriers to increased intakes of vegetables and fruits (Kilcast *et al.*, 1996:48-5; Dittus *et al.*, 1995:120-126). Another study amongst low income, multi-ethnic worksite groups in the USA highlighted perishability, inconvenience, cost, storage difficulties, preparation time, taste dislikes, poor availability and difficulty changing old habits as possible barriers (Cohen *et al.*, 1998:381-386; Cox *et al.*, 1996:44-47). Frozen vegetables might be a solution to some of these barriers such as poor availability, perishability, preparation time and inconvenience.

According to Du Plessis *et al.* (1994:17-18), the frozen vegetable industry in South Africa has been stagnating and constitutes less than four per cent of national consumption. Du Plessis *et al.* (1994:17-18) continue that given the relative low cost of the fresh product, the strategy of the frozen industry has always been one of differentiation. Between frozen and fresh vegetables, where the differentiation strategy delivers less than modest value, the educational process assumes greater importance (Du Plessis *et al.*, 1994:17-18).

For many families, increasing the consumption of fresh fruits and vegetables means undoing existing food habits which is not an easy process. Food decisions are made by families at many levels according to who prepares the shopping list, who does the shopping and who ultimately decides what foods are served at mealtimes. Food preferences, cultural beliefs and food availability can also influence those decisions (Powers, 1996:12-15).

Important elements in a consumer's decision-making process are attitudes towards a product or service. Consumer attitudes are probably the most considered concept in the study of consumer behaviour. During the process of attitude formation towards a specific product, the cues and signals of value regarding that product's attributes are of paramount importance. When there is a positive attitude towards a product, the likelihood of a person buying the product is favourable (Du Plessis *et al.*, 1994:17-18).

Satisfaction with a product also plays an important role and may lead a consumer to buy a product again and foster a positive attitude towards the product. Products or services should provide value to consumers. Consumers, however, frequently do not fully understand in advance all the ways in which a product might provide value. Sellers have the opportunity to take this inadequate knowledge regarding value and educate buyers about differentiating features. By this they can endeavour to change their attitudes towards products (Du Plessis *et al.*, 1994:17-18).

One consistent finding from community-based randomized trials of interventions to increase vegetable intakes is that secular trends in the control group, or dietary self-change, are almost as large as changes attributed to the intervention (Kristal *et al.*, 2000:380; Beresford *et al.*, 1997:610; Tiley *et al.*, 1999:284; Cambell *et al.*, 1999:1390). Therefore, further insight into the psychosocial factors (such as self-efficacy, attitudes, beliefs, and barriers) and dietary habits associated with high vegetable consumption in the

general population may be useful in designing more effective interventions to increase vegetable intake. The psychosocial items also may be useful as mediating factors in the evaluation of intervention programme effects, i.e., programme effects may occur as a consequence of changes in these psychosocial variables (Satia *et al.*, 2002:247–254).

The consumer's attitude towards a product plays an important role in his purchasing decision. Research on the attitudes of consumers in South Africa towards frozen vegetables is limited. Therefore, in this study the attitudes of consumers towards frozen vegetables were investigated. Attitude may be defined as a positive or negative feeling towards an object, issue or person (Foley *et al.*, 1979:13-18). An attitude, in buyer behaviour terms, is a lasting, general, evaluation of products and ideas. Attitudes are formed by personal usage or trust in the attitudes of other influential users (beliefs may be formed without product experience) (Sargeant & West, 2001:71). Studies on attitudes can help health professionals to formulate effective objectives for programmes and to develop relevant techniques for health education (Foley *et al.*, 1979:13-18).

## **1.2 Objectives of the study**

The overall purpose of this research was to investigate the attitudes of adults towards to frozen vegetable consumption.

In more specific terms, the objectives of this study were:

- To establish whether different living standards have an influence on the consumers' attitudes towards frozen vegetables
- To establish if various age groups had different attitudes towards frozen vegetables
- To determine whether education played an important role in consumers' attitudes towards frozen vegetables
- To determine whether different race groups had different attitudes towards frozen vegetables
- To establish whether there was a difference in attitudes towards frozen vegetables between men and women.

## **1.3 Variables**

The variables were subdivided into the groups depicted in Table1.1. These were gender, living standard measurement (LSM), age, race and education.

**Table 1.1 Variables and their subgroups used in this study**

Variable	Subgroups									
GENDER	Men					Women				
LSM	2	3	4	5	6	7	8	9	10	
AGE	18 – 30		31 - 45			46 – 60			61 +	
RACE	Black		White			Coloured			Indian	
EDUCATION	Less than high school					More than primary school				

LSM (Living Standard Measure) divides the population into nine LSM groups, 10 (highest) to 1 (lowest) according to their living standard (Haupt, 2003)

### 1.4 Product characteristics

The following specific product characteristics were used in this study to determine the attitudes of consumers: convenience of preparation, shelf life, taste, choice, appearance and health/nutritional value of frozen vegetables. These characteristics were compared between subgroups within a variable.

Figure 1.1 demonstrates the different product characteristics and the five variables that were used in this study.

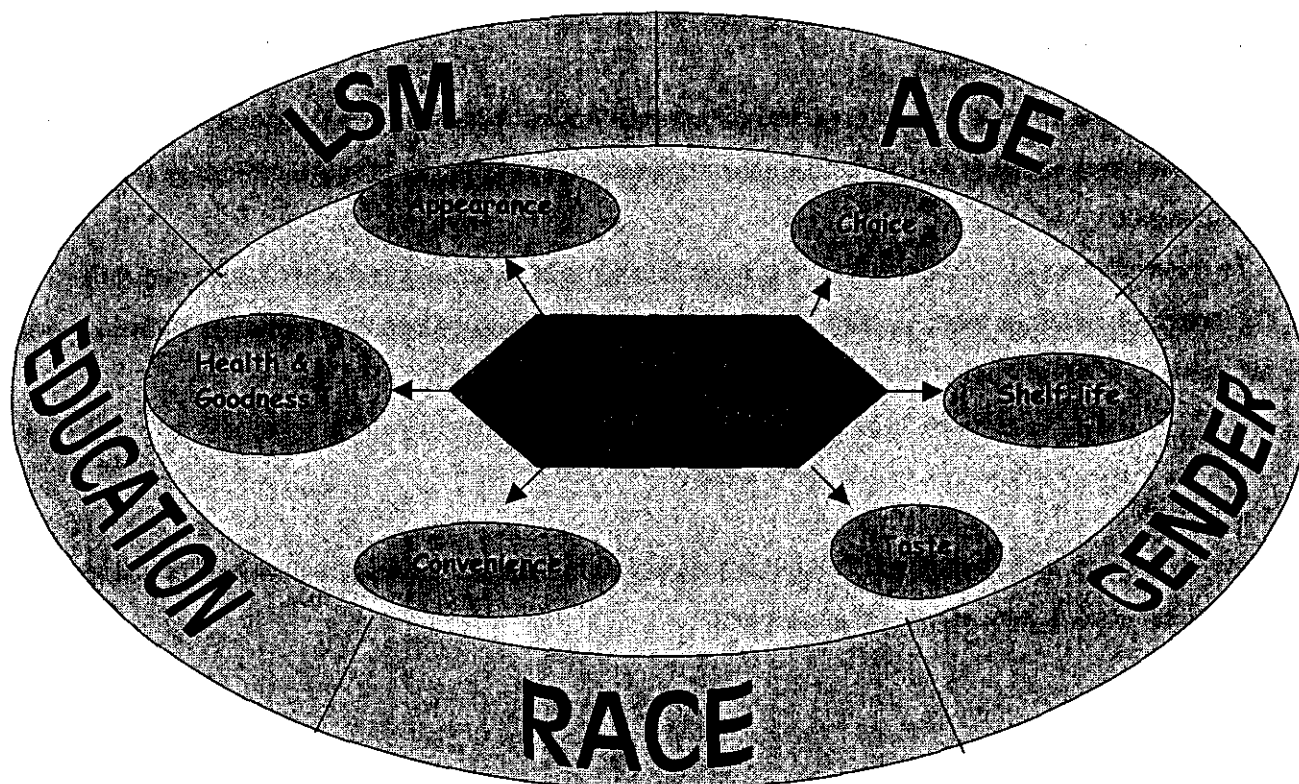


Figure 1.1 Attitudes of consumers towards frozen vegetables compared between variables.

## **1.5 Definition of terms**

The following definitions apply to terms used in the context of this mini-dissertation.

### **1.5.1 Attitude**

Attitude may be defined as a positive or negative feeling towards an object, issue or person (Foley *et al.*, 1979:13-18).

### **1.5.2 LSM (Living standard measure)**

LSM divides the population into ten LSM groups, 10 (highest) to 1 (lowest). The LSM is a unique means of segmenting the South African market. It cuts across race and other outmoded techniques of categorising people and, instead, groups people according to their living standards using criteria such as degree of urbanisation and ownership of cars and major appliances (Haupt, 2003).

### **1.5.3 Freezing process**

Freezing can preserve many foods and this has become a popular method because of its relative convenience and the quality of many foods after freezing. With freezing and frozen storage there is only limited quality loss for up to 6 months or even 12 months with somewhat more deteriorative changes in quality than in safety. Freezing retards growth of micro-organisms by killing some and slowing reproduction of others. The extent of control depends on the temperature maintained during frozen storage (McWilliams, 2001).

### **1.5.4 Blanching**

Blanching is the exposure of the vegetables to boiling water or steam for a brief period of time. The vegetable must then be rapidly cooled in ice water to prevent it from cooking. Blanching also helps to destroy microorganisms on the surface of the vegetable and to make some vegetables, such as broccoli and spinach, more compact (Penner, 1982:1–8). The heat of blanching is also effective in killing many of the microorganisms that are present even after washing. Blanching sets chlorophyll that gives the bright green colour seen in frozen vegetables (McWilliams, 2001).

## **1.6 Delimitations**

Because of the way some of the statements were structured, they could have been misinterpreted. This might have lead to incorrect conclusions. The attitude statements were formulated by partners in the food industry and not validated scientifically.

Another misconception is that LSMs can be used as a psychographic or attitudinal measure. LSMs can tell a marketer that those in LSM 10 for example, have more commodities than others. It doesn't tell their income, or whether they are predisposed towards spending money. To say that a product is being targeted at LSM 10 is to miss the point. LSMs™ are thus not an alternate label for income. Income is actually very often a misleading variable on which to base a marketing strategy, especially if the predisposition of the person towards spending is not known (Haupt, 2003).

## **1.7 Importance of the study**

Vegetables and fruit appear to confer protection against various diseases, but most adults in South Africa eat substantially less than the recommended amounts. Many barriers and factors that influence vegetable consumption have been identified in the literature. One major barrier is the perishability of vegetables and, therefore, other strategies to increase consumption should be investigated. Frozen vegetables might be a possible solution. Research on the attitudes of consumers in South Africa towards frozen vegetables is limited and more research is important in this field. The purpose of this study was, therefore, to determine the attitudes of consumers regarding the link between frozen and fresh vegetables and health and the attributes of frozen vegetables. Studies on attitudes can help health professionals to formulate effective objectives for programmes and to develop relevant techniques for health education (Foley *et al.*, 1979:13-18).

## **1.8 Organization of the mini-dissertation**

It was discussed and decided to choose the article option to report on consumers' attitudes regarding the link between health and fresh and frozen vegetables and the attributes of frozen vegetables. A marketing research company, MARKINOR, was contracted to administer the questionnaires. After the study leaders identified the applicable statements, the researcher did the literature research, analysed all the data statistically, interpreted the results and documented the study in the article and mini-dissertation format.

Chapter 2 will give an overview of the literature covering the background information of available data on the objectives set above. Firstly relevant information regarding the importance of vegetables as well as available data on the attitudes of consumers towards vegetables will be discussed. A closer look will be taken into the factors that influence vegetable consumption as well as the availability of vegetables in South Africa. Background information regarding the characteristics of the frozen vegetable market and the freezing process will also be reviewed. It was also decided to discuss the influence of vegetable freezing on micronutrients in detail. The reason being the fact that vegetables and fruit are especially important for their rich source of micronutrients which were shown to protect against many diseases. Finally Chapter 2 will report on the attitudes of consumers towards frozen versus fresh vegetables.

Chapter 3 is the manuscript prepared for submission to the Journal of Family Ecology and Consumer Sciences. The title page and the abstract in Chapter 3 is followed by the journal specific guidelines for authors.

After each chapter the relevant references will be given. The references for Chapter 1 and Chapter 2 will be listed according to the guidelines provided by the Potchefstroom University. The references for Chapter 3 will be listed according to the journal specific guidelines. The appendix will contain additional graphs with different depictions of the results from this study.

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# Chapter 2: Literature review

## 2.1 Introduction

This review provides background information related to vegetable and fruit health issues, factors affecting consumption and the freezing process. The effect of vegetable processing on micronutrients and consumer's attitudes towards fresh versus frozen vegetables are also reviewed in this chapter.

## 2.2 Health benefits of vegetables

Vegetables, unless fried, are relatively low in kilojoules while supplying many needed nutrients. As a plant-based food, vegetables are a source of phytochemicals, anti-oxidants, minerals and dietary fibre which help to decrease disease risk. The majority of data is showing beneficial effects of fruit and vegetable intake on risk of disease, particularly cancer and coronary artery disease. These data have historically been obtained from many case-control studies (Hyson, 2002:3; Kolonel *et al.*, 2000:795; Steinmetz & Potter, 1996:1027). Prospective trials have also been conducted to determine if fruit and vegetable intake affects the development of these conditions over an extended period of time. The current evidence collectively demonstrates that fruit and vegetable intake is associated with improved health, reduced risk of major diseases and possibly delaying the onset of age-related indicators (Hyson, 2002:3). As a result, many countries have dietary guidelines with recommendations to consume more fruits and vegetables (Kolonel *et al.*, 2000:795 ; Steinmetz & Potter, 1996:1027).

- Vegetable and cancer

As proved by various studies, fruit and vegetable consumption is among the many factors that might influence the risk of developing cancer (Hyson, 2002:6). There are still many unresolved questions regarding the true association between fruit and vegetable intake and cancer risk, due to the complex etiology and the varied forms of different cancers. However, while the prospective studies are less convincing than the case-control studies, there is ample data to suggest that fruit and vegetable intake is likely to be protective for most cancers (Hyson, 2002:6; Stables *et al.*, 2002:809-817). There is currently more focus in current investigations towards biomarkers of cancer risk and examination of plausible mechanisms by which fruit and vegetable intake might be protective. This promises to provide important information to characterize the association between fruit and vegetable consumption and cancer (Hyson, 2002:6).

- Vegetables and cardiovascular disease (CVD)

Mortality and morbidity associated with CVD have great potential to be reduced by lifestyle changes, including dietary factors. There are a diverse array of substances in fruits and vegetables associated with decreased risk of CVD including antioxidants, folate, fibre, potassium, flavonoids and other phytochemicals. According to a literature review done by Hyson (2002:6), a number of past reports

have summarised data from case-control studies showing a beneficial effect of fruit and vegetable consumption on risk of CVD. Hyson (2002:6) also found that more recent prospective studies have added to the growing evidence that fruit and vegetable intake reduces risk factors as well as incidence and mortality associated with CVD.

- Vegetables and hypertension

In the Dietary Approaches to Stop Hypertension (DASH) trial previously, it was found that 8.5 servings or more of fruit and vegetable per day (particularly in combination with low-fat dairy products), effectively lowers blood pressure in subjects with normal and high blood pressure (Appel *et al.*, 1997:1117–1124). Hyson (2002:8) remarked that hypertension is associated with increased risk of CVD, stroke, and renal dysfunction. From the data obtained in the DASH trial, it was also found that diets incorporating fruits and vegetables are an important first line of defense against these conditions.

According to Mahan & Escott-Stump (1996:558-559) population studies found that dietary potassium (found in fruit and vegetables) and blood pressure are inversely related. It was found that higher potassium intakes are associated with lower blood pressures. Magnesium, also found in fruit in vegetables, is a potent inhibitor of vascular smooth muscle contraction and may play a role in blood pressure regulation as a vasodilator. An inverse relationship has also been reported between dietary magnesium and blood pressure (Mahan & Escott-Stump, 1996:558-559).

- Vegetables and diabetes

In the United Kingdom, in the European Prospective Investigation into Cancer, the association between fruit and vegetable intake and glucose levels was studied in over 6000 non-diabetic men and women (Sargeant *et al.*, 2000:342-348). It was found that glycosylated hemoglobin levels, an indicator of long-term blood glucose control, tended to be higher in subjects with the lowest consumption of fruit and green leafy vegetables after adjustment for dietary fibre, dietary and plasma vitamin C and a number of other potential cofounders (Sargeant *et al.*, 2000:342-348). There are a number of possible mechanisms by which fruit and vegetable consumption might reduce risk of diabetes. These include positive effects on the control of glucose and peripheral insulin sensitivity may probably be mediated by fibre and magnesium, as well as potential benefits from antioxidant vitamins and phytochemicals found in fruit and vegetables (Hyson, 2002:10).

- Vegetables and obesity

A long-term imbalance between energy expenditure and energy intake is important in the development of overweight and obesity. Specific dietary factors associated with the prevention of overeating are receiving much attention. Energy density, fibre content, palatability and dietary variety are thought to be important determinants of energy consumption. The inclusion of fruits and vegetables in the diet has the potential to affect each of these factors (Hyson, 2002:10). Burton-Freeman (2000:272S–275S) also reported that foods containing dietary fibre have been proposed to slow gastric emptying and favourably

impact satiety. This results in a sustained feeling of fullness that may reduce overeating. Hyson (2002:11) concludes that although not tested directly, fruits and vegetables, because of their fibre content, would be expected to be positively associated with increased satiety and reduced overall energy intake.

- Vegetables and bone health

A strong correlation between potassium and magnesium intakes and bone density was found in the Framingham Heart Study, which suggests that fruits and vegetables may play a role in bone health due to their content of these two micronutrients. The mechanism for the potential protective effect thereof is not clear (Tucker *et al.*, 1999: 727-736). Current available data suggest that there may be a link between bone health and fruit and vegetable consumption, but further investigation is needed to confirm the mechanisms and specific constituents in fruits and vegetables that might account for the association (Hyson 2002:12).

- Vegetables and aging

Aging is associated with a decline in neuronal function as well as physical and behavioural changes. It is hypothesised that enhanced vulnerability to oxidative stress is an important factor in the etiology of neuronal loss associated with aging. Therefore, there is an increasing interest in the potential of antioxidant nutrients and flavonoids in fruits and vegetables to attenuate the effects of aging (Hyson, 2002:12).

- Vegetables and neurodegenerative diseases

Oxidative stress is also a risk factor for neurodegenerative diseases such as Alzheimer's and vascular dementia. Antioxidants (including polyphenols present in fruits and vegetables) have been proposed to have a protective effect on vascular dementia and Alzheimer's (Commenges *et al.*, 2000:357-363).

- Vegetables and diverticulosis

From a literature review on the health benefits of vegetables done by Van Duyn (2002: 13), an association between the fibre from fruits and vegetables and a lower risk of diverticulosis was found. Various results from different studies highlight an opportunity to promote the fact more widely that fruits and vegetables provide dietary fibre and that the insoluble fibre and especially the cellulose in fruits and vegetables, may be particularly important in helping prevent diverticulosis (Van Duyn, 2002:13).

- Vegetables and eye health

Fruit and vegetables have shown a new, protective and unique role in cataract prevention. Cataracts occur when the lens of the eye is unable to function due to opacities. Lens opacities develop when proteins in the eye are damaged by photo-oxidation, and if left untreated, can lead to eventual blindness. Antioxidants such as vitamin C and carotenoids are believed to be the first line defense systems protecting the initial oxidative stress (Van Duyn, 2002:15). According to Taylor *et al.* (1995:1439S-

1447S), optimising nutrition, including diets rich in fruits and vegetables, may provide the least costly and most practical means to delay cataracts.

Current evidence supports a significant association between fruit and vegetable intake and health. Hyson (2002:15) concludes that there is ample scientific data to support a dietary guideline goal of consuming 5 – 10 servings of fruits and vegetables each day and that there is a strong suggestion that increased fruit and vegetable consumption could have significantly positive effects on improving the health of the nation.

### **2.3 General attitude towards and consumption of vegetables**

The National Cancer Institute (NCI) conducted a survey in 1991 which determined that on average Americans eat less than three servings of fruits and vegetables a day. In 1992 the NCI, along with the Produce for Better Health Foundation (PBH), launched a public education programme entitled "5 A Day for Better Health" to increase consumer awareness about the importance of fruits and vegetables in the diet (Kurtzwell, 1997:17-23).

The NCI/PBH survey indicated that consumers were listening to the message and follow-up surveys show the percentage of consumers aware of the "5 A Day" goal rose by 27% from 1991 to 1996 (Kurtzwell, 1997:17-23). However, the United States Department of Agriculture's (USDA) Economic Research Service found only a 3% increase in vegetable consumption since 1978 and the recommended yellow and green vegetables consumption was low (Munoz *et al.*, 1997). According to a recent investigation, fewer than 1% of young Americans meet the overall recommended guidelines for a healthy diet and only about one-third ate the recommended amounts of vegetables (Patterson *et al.*, 1990:1443-1449). Subar *et al.* (1995:352–360) found that survey data from the 5-A-Day programme indicated that 3.5 servings of fruits and vegetables was the median for most adults and less than one-quarter ate five servings.

According to Love and Sayed (2001:29), regional and *ad hoc* food and nutrient studies in South Africa describe black rural dwellers as eating two main meals a day consisting of mealie-meal with green leafy vegetables, wild spinach or pumpkin. Black urban dwellers were found to be eating vegetables and fruits in small amounts, usually one small portion twice a day, with women consuming notably more vegetables and fruits than men. Love and Sayed (2001:29) found that only a few studies have investigated vegetable and fruit intakes of Indian and white urban dwellers. It was found with qualitative descriptions that vegetables are eaten in small amounts at the two main meals, and may also be prepared with oil, margarine, butter or other types of cooking fat. Also, a variety of fresh, frozen and canned vegetables as well as fresh fruit and fruit juices are eaten, but in small amounts, about one to

three times a week. Love and Sayed (2001:29) concluded that the overall intake of vegetables and fruits for South Africans does not meet the global recommendations of five portions daily.

Interventions to increase fruit and vegetable consumption only achieved modest success. The most successful interventions in the United States have rarely observed effects of more than half a serving of fruits and vegetables (Kristal *et al.*, 2000:380; Beresford *et al.*, 1997:610; Tiley *et al.*, 1999:284). Studies on barriers and incentives to increase fruits and vegetables have been carried out in Scotland (Anderson *et al.*, 1994: 55-64). The results showed that many people have low motivation towards changing their diet and that over 50 per cent of respondents with low fruit and vegetable intakes (less than two portions per day) felt they were eating the right amount. Cost, lack of willpower and family influences were reported by Cox *et al.* (1996:44-47) as the main barriers for increased consumption.

De Geest *et al.* (1994:233) also found that it may be more challenging to increase vegetable intake compared with fruits, which are easier to purchase, require little preparation and have a sweet taste. The majority of studies were done on increasing fresh fruit and vegetable consumption and as quoted by Kurtzwell (1997:17-23), "fresh fruits and vegetables are not the only way to achieve the "5 A Day" goal, but consumers and health professionals tend to focus on this form".

To be more successful, nutrition promotion efforts to encourage higher vegetable consumption must incorporate processes and factors associated with adopting healthful vegetable-eating habits in the general population (Satia *et al.*, 2002:247-254).

Sargeant and West (2001:97) state that the formation of attitudes is linked to a basic survival and coping requirement. Attitudes help to make sense of the world and to maintain self-image. There is a social component in holding many attitudes. Attitudes are formed individually, but there are interactions with other people in their formation, particularly with family and friends. Attitudes enable people to rebel or integrate (identify) with their groups and society at large and attitudes towards products are part of this process (Sargeant & West, 2001:97).

In the attitude-social-influence efficacy (ASE) model (Fig.2.1 below), behaviour is considered to be a result of behavioural intention (Brug *et al.*,1995:285). Three main psychosocial factors have been identified that predict (health-related) behavioural intention: attitudes, social influences and self-efficacy. Brug *et al.* (1995:286) explain that a person's attitude towards a specific behaviour is a result of the consequences that a person expects from performing the behaviour. Brug *et al.* (1995:285) also state that social influence is a result of social norms relevant to the behaviour, support from others to perform or refrain from the behaviour and whether important others perform or refrain from the behaviour themselves. Self-efficacy expectations can be seen as a person's belief whether he can perform the desired behaviour and can cope with barriers that may hinder actual performance. This model implicates that a person's health behaviour can be changed by changing his attitude, his perception of

social norms and social support and his self-efficacy expectations. The external variables, such as socio-demographic factors, are expected to influence behaviour through the behavioural determinants and intention. Self-efficacy not only influences behavioural intention but also has a direct influence on behaviour. The last step, behaviour, or trying to perform the behaviour will lead to feedback that may influence the determinants (Brug *et al.*, 1995:286).

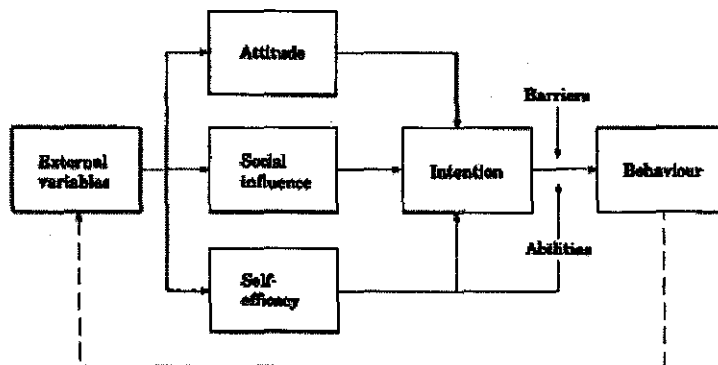


Fig 2.1 Attitudes, social influences and self-efficacy (ASE) model of determinants of behaviour (Compiled from De Vries *et al.*, 1988 and De Vries & Backbier, 1994 in Brug *et al.*, 1995:286)

## 2.4 Factors affecting vegetable and fruit consumption

### 2.4.1 Social interactions

Food is one of the key focuses of social interactions. It was found in one German study that pleasure from food was only partly determined by the sensory aspects of the food items (Pollard *et al.*, 2002:378). Many factors such as atmosphere, the table, mood and people were all important aspects of the pleasure gained from eating occasions. Because many eating occasions occur in the company of others, they may affect the types and amounts of food eaten. One study conducted in the UK discovered that lower consumers of fruit and vegetables had a tendency to consume more of their meals in the living room in front of the television compared with other rooms (Thompson *et al.*, 1999). It was also found in a second study that subjects did not 'take the trouble' to prepare boiled vegetables and salads if they were eating alone, but will prepare vegetables if they were preparing food for others (Brug *et al.*, 1995). This could give an explanation for the differences in intakes observed in a number of studies between individuals with differing marital status. Being married was found to be associated with increased fruit and vegetable intakes, whilst being single, separated or divorced may be associated with lower intakes (Pollard *et al.*, 2002:378).

In the UK social pressures for groups of the population have been described to influence consumption or avoidance of certain foods. It was also found in one study that subjects who thought they consumed

high amounts of fruit and vegetables were more positive in attitude and experienced more social influence to consume fruit and vegetables than lower consumers (Cox *et al.*, 1996). Another study that used the theory of planned behaviour to predict intention to increase fruit and vegetable intake found that the perceived social pressure to increase consumption was low. However, where a social pressure was felt, it was positive towards increasing fruit and vegetable intakes (Cox *et al.*, 1996).

Pollard *et al.* (2002:378) speculate that the large differences in intakes of fruit and vegetables between differing social classes may be due mainly to monetary concern but that it could also partly be due to different social pressures and interactions. A study conducted in Sweden investigated how social networks and social support affected the socioeconomic differences in fruit and vegetable consumption (Lindstrom *et al.*, 2001). The social network variables explored social participation within various formal and informal groups in society and also with feelings of membership within particular groups. It was found that low social participation was able to explain some of the differences in consumption of vegetables between differing socioeconomic groups. It was also hypothesised that perhaps without social participation, and thus social support, it is more difficult to adapt the diet and change to incorporate dietary recommendations. An example of this was found in the area of obesity management, where a lack of social support was found to be a barrier to successful weight loss (Perri *et al.*, 1993).

#### **2.4.2 Race**

Cultural habits and traditions are important determinants of food consumption, with different countries and regions having different cuisines. A regional variation in the intake of carotene, vitamin C and, most markedly, in vitamin E is seen in many countries (Leather, 1995:10–17). People living in Scotland and the north of England generally have lower intakes than those from the Midlands, South West, Wales, London and the South East (Leather, 1995:10–17). However, the regional variations are considerably smaller than the social class variations in intake (Leather, 1995:10–17).

The South African Food-Based Dietary Guidelines Consumer Study indicated a number of constraints with adequate vegetables and fruit consumption (Love *et al.*, 2001:9-19). They found that among black rural, informal urban and formal urban dwellers, affordability (lack of household income) was the primary constraint. Also, for all groups (black, coloured, Indian and white), fruit consumption was strongly related to availability and highly contingent to seasonal fluctuations. All groups also stated that with regard to taste, most resistance to vegetable and fruit consumption came from the children and, in some cases, the men in the household (Love *et al.*, 2001:9-19). Strategies to increase vegetable consumption should be investigated.

Khan (1981) as quoted by Pollard *et al.* (2002:377) described food habits as the way in which individuals in response to social and cultural pressures select, consume, and utilise portions of the available food

supply. He stated that food habits evolve from learned experience, which leads to the development of attitudes towards food and is, therefore, a form of self-expression. Modeling has been said to be an indispensable aspect of the learning process. In a Dutch study it was found that habit is a strong determinant for the consumption of boiled vegetables, salads and fruit. The subjects stated repeatedly that they were eating the way that they were taught at home in the past and continued to eat according to those habits when they left their parents to go and live on their own or to start their own family (Pollard *et al.*, 2002:377).

Food habits play a very important role in cultures and traditions (Pollard *et al.*, 2002:377). Food choice decisions are said to be built on cultural and traditional practices (Pollard *et al.*, 2002:377). Due to the boundaries laid down by cultures and traditions, some of the largest variations in food choice are seen, because they give values and beliefs in different foods and eating patterns. This provides the framework within which an individual's food choice may evolve. Many dietary restrictions play a part in religious and cultural beliefs, although none of these include restrictions on fruit and vegetable intakes. Some religious groups, however, do follow strict diets that are believed to be beneficial. For example, many Buddhists follow a macrobiotic diet and lifestyle which groups food into the Yin (expansive) or Yang (contracted) state and the diet is used to balance the 'environment, lifestyle and constitution'. Particular focus is placed on vegetables in this diet. Vegetables such as broccoli, leeks and carrots may be used regularly, but restrictions are put on other varieties such as celery, parsnip and peas (Pollard *et al.*, 2002:377).

Although the impact of culture on food choice is immense and varied, there are still many differences in food choices and in food likes and dislikes among members of the same culture (Rozin & Vollmecke, 1986). In the case of food neophobia (the initial rejection of novel foods), rejection can be overcome by repeated exposure to and consumption of the novel food item (Kovisto & Sjoden, 1997). Thus, although familial resemblance in food neophobia has been found, this is likely to be due to familiarity and habit as opposed to heredity. A US study carried out with university students to investigate the psychological basis of food rejection showed that food rejection behaviour could be categorized into four areas (Fallon & Rozin, 1983). These categories were named by the authors as 'distaste' (the person disliked the sensory characteristics of the substance), 'danger' (the person felt that there would be negative consequences after consuming the food), 'disgust' (where the person found the idea of eating something offensive) and inappropriate (where a person classified a substance as not edible). In a Scottish study, using focus group sessions, it was found that the participants had a strong preference for familiar vegetables. From the questionnaire which followed, it was discovered that subjects thought that opportunities to try unfamiliar fruits and vegetables in supermarket taste sessions could be a good way to help increase consumption (Pollard *et al.*, 2002:378).

### 2.4.3 Gender

The existence of a food hierarchy or food ideology is commonly referred to in the food choice literature (Charles & Kerr, 1988; O'Doherty & Holm, 1999). The position a food holds within this hierarchy does affect whether or not that food is consumed, particularly in higher socioeconomic groups. This food ideology also describes how some foods at the top of the food hierarchy (such as red meat and alcohol), are particularly related to maleness and as such are a symbol of masculinity. Vegetables, in comparison, are seen as women's food and, therefore, undesirable to men. A number of studies throughout Europe concluded that a greater proportion of the energy consumed by men came from meat, animal products and alcohol, while that of women came from vegetable products and fruit. This food ideology may, therefore, account for some of the differences found in fruit and vegetable intake patterns between men and women (Pollard *et al.*, 2002:379).

Rappoport (1993:33-52) carried out a study in the USA which was based on subjects' evaluations of specific meals and snacks. It uncovered a wide range of male and female differences. One important finding was that women tended to favour healthier meals, in that they rated such meals higher on dimensions of pleasure, convenience and health than did men. Two large-scale surveys of the Norwegian population, carried out in 1994, suggested that women had made dietary changes in line with official recommendations, and that they had higher levels of health knowledge than men (Fagerli & Wandel, 1999:171-190). Women were also more likely than men to report a decrease in meat consumption and less likely to see meat as important for healthy eating (Fagerli & Wandel, 1999:171-190). Also, although both sexes reported reducing consumption of certain high fat food items, women seemed to be more inclined to make dietary changes aimed at weight loss. Women also reported a greater inclination to make changes in line with official dietary guidelines (Beardsworth *et al.*, 2002:470-491).

In the research done by Beardsworth *et al.* (2002:470-491), questions which probed food-related work and responsibilities produced clearly gendered outcomes. Women overwhelmingly reported that it was they who bore the main responsibility for deciding which foods are purchased.

Collectively these differences seem to provide a picture which suggests that men have a significantly more "robust" and "conservative" view of eating, as compared with the more "sensitive", "caring", "aware" and indeed "problematical" views of women (Beardsworth *et al.*, 2002:470-491).

It was also found that these gender differences in food-related issues and concerns are particularly interesting in relation to the issue of body image. Beardsworth *et al.* (2002:470-491) found in their study that women are more likely to be concerned about and to take steps to alter their body image. These concerns are frequently attributed to the role of the mass media in promoting a culture of female thinness, in large part through a celebration of thin models and actresses. Beardsworth *et al.* (2002:470-491) conclude that their findings, on the other hand, suggest that many of the contrasts in attitudes and

behaviour between women and men in connection with body image are related to a complex of gender differences in food choices and eating patterns (Beardsworth *et al.*, 2002:470–491).

Both sexes express confidence in relation to healthy eating and stress the pleasure they derive from food (Beardsworth *et al.*, 2002:470–491). But distinctively male and female patterns do emerge and can be summarised as follows: by and large men have fewer moral and ecological misgivings related to eating, they favour meat consumption and traditional meals, being less inclined to try new foods. They are less involved in food work, have lower culinary skills and are less inclined to restrict food intake. In contrast, women express more ethical concerns in relation to food and are less inclined to take an unreflective and unworried stance. They are shown to be more sympathetic to novel food items and dietary change and are more involved in, and skilled in, food work. Women are also more likely to experience guilt (by feeling "controlled" by food) and to use food as an antidote to unwelcome states of mind (Beardsworth *et al.*, 2002:470–491).

#### **2.4.4 Levels of income**

Although people on a lower income spend less money, a greater percentage of their income is spent on food. Potentially this has important implications for the likelihood of their adopting healthy eating practices. It was found that people on a lower income were eating more red meat, hamburgers, sausages, whole milk, white bread and chips and less fruit and vegetables, low-fat milk, lean meat and whole-wheat bread (Shepherd *et al.*, 1996:19-21). There may be some cause for concern in relation to the healthiness of the diet in this group (Shepherd *et al.*, 1996:19-21)

Shepherd *et al.* (1996:19-21) state that positive attitudes towards eating a healthy diet are expressed by people of all income levels and, therefore, it would seem to be unlikely that general attitudes towards healthy eating were the major determinant of differences between the diets of higher and lower income people. They found that a change in income has a destabilizing effect on food habits. When there is a decrease in income, it will lead to a change in the variety and quantity of foods eaten. If there is a long-term reduction in income, it may lead to a greater proportion of income being spent on food, but a reduction in intake of several foods currently recommended for a healthy diet. In contrast, an increase in income did not necessarily lead to increased expenditure on food nor improved diet quality overall (Shepherd *et al.*, 1996:19-21).

Some groups of the population are more affected than other groups by the cost of food which is a major determinant of food choice. Pollard *et al.* (2002:379) report that according to a Mintel report on the market drivers of fresh fruit and vegetables, there is an ongoing shift in the fruit and vegetable market from loose to prepacked, prepared and ready-to-cook products. More than 60% of the expenditure in the vegetable sector in the UK is now on pre-packaged produce. Although these products are more expensive than loose produce, consumers were found to be more willing to take in the extra cost in a trade off for convenience. Some customers, however, are still unable to take in the extra costs. Price

has been found to be most influential in the food choice of those in lower socioeconomic groups, for example students, the retired and the unemployed (Pollard *et al.*, 2002:379)

According to the Ministry of Agriculture, Fisheries and Food (1999), those in lower socioeconomic groups consume less fruit and vegetables than those in higher socioeconomic groups. In a particular study it was found that recommended foods following UK national dietary guidelines were more expensive than alternative foodstuffs, particularly in deprived areas (Moony, 1990). Also, another UK study which was set up to investigate direct and indirect costs of a healthy diet, found a healthy diet to be more expensive in monetary terms (Cade *et al.*, 1999). Subjects in this study with the healthiest diets were found to spend three times as much on fruit and vegetables than those with the lowest healthy diet score (Pollard *et al.*, 2002:379).

It is very important that intervention messages take price into account when encouraging increased consumption of vegetables (Pollard *et al.*, 2002:380). To be able to eat more vegetables in the form of vegetable-based dishes requires some degree of skill and probably experimentation with new recipes and varieties of vegetables. This may be a risk in low-income households. When experimenting with new varieties of vegetable dishes, the family may not like them, in which case a replacement meal must be found and this can become expensive. In-store cooking demonstrations and food tasting could provide opportunities for consumers to try new fruits and vegetables at no cost (Pollard *et al.*, 2002:380).

Leather (1995:10-17) found that in the mid-1950s, households in the UK would generally have expected to spend about one-third of their income on food. Currently the average has dropped to about 17%, but the poorest still spend between one-quarter and one-third of their income on food. According to Leather (1995:10-17), one of the major retailers recently suggested a healthy diet for people on low incomes. The fact that it took up over 40% of the income of families on benefit amply demonstrated the difficulties faced by many people in simply affording an acceptable healthy diet.

The Policy Studies Institute in the UK recently reported that food played a pivotal role in the domestic economy of low-income families (Kempson *et al.*, 1994). Vegetables were found to be a necessity which was given a high priority in terms of expenditure, but were also one of the easiest items to cut back on. According to Leather (1995:10-17), this also accounts for the marked socio-economic differences in both the quality and frequency of consumption of fruit and vegetables. In 1993, the dietary and nutritional survey of British adults done by the Ministry of Agriculture, revealed that when taking the UK as a whole, the main dietary differences by socio-economic group were as follows:

- Higher social classes are more likely to drink fruit juice, to eat fruit and vegetables, especially salad vegetables, oily fish and shellfish, all dairy products, buns, cakes and pastries, chocolate confectionery and polyunsaturated margarine than lower social classes
- Recorded intakes of vitamins are significantly greater in higher social classes, particularly among women

- These differences in food intake help to explain the significantly lower intakes of sugars, fibre, calcium, total carotene, vitamin C and *n*-3 and *n*-6 *cis*-polyunsaturated fatty acids for men and women in lower social classes in the UK
- The nutrients calcium, carotene and vitamin C were overall showing the largest variation between social classes (Leather, 1995:10-17).

Leather (1995:10-17) states that in terms of choice, poorer consumers choose wisely, buying the cheaper varieties, fewer beans, peas, broccoli, leafy salads, but more cabbage and turnip and more than double the amount of potatoes. The differences between rich and poor were seen clearly in the more expensive items like salads, cucumbers, mushrooms and tomatoes (Leather, 1995:10-17).

#### **2.4.5 Convenience**

With the upcoming era of prepared and take-away foods (convenience food), vegetables now need to be positively promoted. Although fresh vegetables are available and cost effective in South Africa, many people do not eat enough vegetables (Vorster *et al.*, 1997). There are many reasons for this but it seems that time constraints are a big issue in food choice and that individuals make constant conscious choices around issues of convenience. Consumers do not have the time available to go shopping and to prepare the vegetables when they come home (Pollard *et al.*, 2002: 373). According to Pollard *et al.* (2002: 373), an UK study found that focus group discussants that were low vegetable consumers, saw storage, wastage and preparation time as constraints. They felt that frozen vegetables might be a possible solution.

Over the years there have been many changes in meal patterns in families. Previously, families sat down to eat a meal together, but now increased frequencies of snacking in order to fit in around hectic lifestyles has led to an increase in consumer demand for ready-made and convenience foods (Pollard *et al.*, 2002:381). Commissioned research at the Leatherhead Food Research Association (RA) has produced evidence that poor convenience image and low taste expectations may be of great importance in limiting vegetable consumption (Kilcast *et al.*, 1996:48-51).

Kilcast *et al.* did research in 1996 to identify ways of overcoming the obstacles to increasing the consumption of both vegetables and fruits and of developing practical strategies for implementing the findings. The consumer research was carried out in two stages. First, convenience issues were addressed through in depth interviews, followed by group discussions with both high and low vegetable consumers. Based on the results of the discussions, a tips brochure and a tasks checklist were designed and issued to the low vegetable consumers for use over a two-week period. Follow-up interviews were then carried out with a selection of these consumers. The results identified some key attitudinal differences between the two types of consumers, with the high vegetable consumers showing active characteristics and the low vegetable consumers passive characteristics (Kilcast *et al.*, 1996:48-51).

High vegetable consumers were characterised by a high level of control over family members and their eating patterns, with a high level of advance planning of meals. They showed an experimental approach to eating, with a strong food focus as part of their lifestyle. The respondents also exhibited high self-esteem regarding the family eating habits (Kilcast *et al.*, 1996:48-51).

Low vegetable consumers were characterised by a spontaneous response (reactive response) to food requests from the family, particularly from children. Those fruits and vegetables that were used were bought as a routine, with very little experimentation. These consumers felt a strong lack of control over family feeding, only being able to cope with the immediate needs of the family. A consequence was that the family members ate different foods at different times. There was also evidence of strong feelings of guilt surrounding the family diet, with consequential low self-esteem. Suggestions to shop at markets were not well received, but there was a very positive response to the large variety of largely untried produce offered at greengrocers and supermarkets. The low vegetable consumers saw storage and wastage as a problem, with frozen vegetables as a possible solution. The low vegetable consumers regarded preparation as time-consuming and had not learned the short-cut techniques of the high vegetable consumers, such as bulk preparation and storage. There was some enthusiasm for suggestions that would increase the variety in the way vegetables could be used (Kilcast *et al.*, 1996).

#### **2.4.6 Sensory appeal**

Food is not just eaten for its nutrient value. According to Clark (1998), it is a source of pleasure, an enjoyable experience and even a comforting activity for many people. Individual properties of food such as taste, texture, quality, smell and appearance play an important role in whether a person will choose to consume an item. In a number of studies it was found that sensory factors are amongst the most influential in determining eating behaviour (Pollard *et al.*, 2002:375). Quality, followed by taste, was the most mentioned influence reported in a pan-European survey looking at consumer attitudes towards food, nutrition and health. This was the case for both the European Union sample and the UK sub-sample (Institute of European Food Studies, 1996). A Dutch survey used focus group interviews to look at determinants of fruit and vegetable intake (Brug *et al.*, 1995). The authors found that, when looking at satisfaction beliefs, good taste was an essential prerequisite for the consumption of fruit and vegetables (Brug *et al.*, 1995). In a US study, focus group participants indicated that good taste was perceived as a benefit of increasing intakes of fruit, although taste was also regarded as a barrier for increasing intakes of cruciferous vegetables (Heimendinger & van Duyn, 1995). Recent work in the area of taste genetics showed that individual differences in the ability to taste certain compounds may be a determinant of food rejections (Fisher *et al.*, 1961; Glanville & Kaplan, 1965). The ability to taste the bitter compounds 6-n-propylthiouracil and phenylthiocarbamide is a genetically inherited trait and that these substances are bitter to some people and tasteless to others (Fisher *et al.*, 1961; Glanville & Kaplan, 1965). More recently research has found that sensitivity to 6-n-propylthiouracil solutions has been associated with more reported food dislikes. Taste preferences have been shown to influence food choice behaviour, but

few studies have examined taste responses, food preference and intake patterns in the same free-living populations (Pollard *et al.*, 2002:375 - 377).

#### **2.4.7 Availability**

According to Pollard *et al.* (2002:380), Mintel reported in 2001 that in the year 2000, supermarkets in the UK had 83% of the market share in fresh fruit and vegetables, compared to 11% for independent greengrocers and 3% for market stalls.

The low-income groups suffer because it is the local retailers on whom families on low incomes and those without transport, rely for their weekly food shopping. Consequently, higher prices for foods are paid or public transport must be used to travel to the new out of town supermarkets. Leather (1995:10-17) found that in 1995 a third of all households are families without their own means of transport.

Pollard *et al.* (2002:380) are of opinion that in relation to fruit and vegetables consumption, availability could account for a large proportion of the food choice process. If individuals are dependent of public transport, or have to walk, fruit and vegetables are heavy and bulky to carry and might not be bought.

In a study done by Cox *et al.* (1996:44-47), the perceived barriers to increasing fruit and vegetables consumption was investigated. It was found that the participants were finding limited availability of vegetables and fruit at work, when eating out, having take-aways and at friends' houses (Cox *et al.*, 1996: 44-47).

#### **2.4.8 Other factors**

Parmenter (2002:23-29) found that people have little motivation to change their diets even when they have the intention to do so. He also states that health concerns and illness provide a catalyst for dietary change and a barrier to increasing fruit and vegetable consumption is that people believe they are already eating enough. Family members may also make dietary changes difficult (e.g. children rejecting vegetables). He suggested that the public needs more information about the daily recommended intake of fruit and vegetables and information about the relationship between diet and disease. Consumers also need practical advice on how to overcome the barriers to dietary change. Barriers which have been identified include the perception that fruit and vegetables are expensive, much time is needed to shop more often for fresh fruit and vegetables, more time is needed to cook vegetables and the convenience of ready meals and fast food. Practical advice to help overcome these barriers could include that fruit and vegetables are not expensive if seasonal varieties are bought. Also, timing can be planned for an extra shop or consumers can use frozen vegetables. Practical advice on ways to cook or eat fruit and vegetables which are not time consuming (eat fruit as snacks or on top of cereal) may be given. By making healthy eating fun for children (e.g. dips with vegetables) and educating parents that children

should be introduced to a variety of healthy food at an early age, some of these barriers can be overcome (Parmenter, 2002:23-29).

In a Scottish study, individuals had perceptions of fruit and vegetables as being boring, associated with slimming, lacking taste and old fashioned (Anderson *et al.*, 1994). These consumers thought that advertising to encourage higher consumption of fruit and vegetables was a good idea (Anderson *et al.*, 1994).

## **2.5 Characteristics of the frozen vegetable market**

Consumers can buy vegetables in four forms namely fresh, frozen, canned and dehydrated vegetables. Fresh vegetables account for 95.4% of the market in South Africa, followed by frozen vegetables 2.1%, canned vegetables 1.4% and dehydrated vegetables 1.1% (Du Plessis *et al.*, 1994:18). The 95% market share of fresh vegetables represents 2000 tons of fresh produce consumed annually. The frozen vegetable market's actual size was approximately 25 thousand tons in 1985, increased marginally annually to reach about 30 thousand tons in 1989 but then declined again to 28 thousand and 29 thousand tons in 1990 and 1991 respectively (Du Plessis *et al.*, 1994:18).

Du Plessis *et al.* (1994:18) state that these figures suggest that the frozen vegetable market has largely stagnated. They also state that a possible explanation for the stagnation is that the frozen vegetable market is an oligopolistic market (three large producers account for 99% of annual output) in which it appears that major producers have done little to expand the frozen vegetable market. High barriers to entry, notably high capital requirements and limited scope to realize economies of scale benefits, could also have resulted in a degree of insensitivity to consumer needs among producers of frozen vegetables.

No other published research findings of similar studies with regard to the frozen vegetable market could be located, both nationally and internationally.

## **2.6 The freezing process**

### **2.6.1 General**

According to the Australian Nutrition Foundation (2001:-3), freezing is a very efficient method of preserving the nutritional value, texture and flavour of many vegetables. Most vitamins will keep well in frozen vegetables.

The technology to freeze certain foods provides the consumer with more food choices. Out of season produce can be available throughout the year. Producers are also able to transport and store foods

without them spoiling. Food scientists can measure the nutrient content of different foods. Foods are analyzed for various minerals, vitamins and fibre. Studies that have compared frozen produce to fresh produce show that in most cases the frozen fruits and vegetables retain their nutrients (Ehler, 2003).

When foods are to be stored for more than a few days before they are eaten, it often requires special treatment to control the micro-organisms with which they may be contaminated. Treatments commonly available commercially and in the home are freezing, canning and drying. There are also two other methods, namely freeze-drying and irradiation, which are used to a limited extent commercially (McWilliams, 2001).

Freezing can preserve many foods and this has become a popular method because of its relative convenience and the quality of many foods after freezing. With freezing and frozen storage there is only limited quality loss for up to 6 months or even 12 months with somewhat more deteriorative changes in quality than in safety. Freezing retards the growth of microorganisms by killing some and slowing reproduction of others. The extent of control depends on the temperature maintained during frozen storage (McWilliams, 2001).

### **2.6.2 Chemical changes during freezing**

Fresh fruits and vegetables, when harvested, continue to undergo chemical changes which can cause spoilage and deterioration of the product. This is why these products should be frozen as soon after harvesting as possible and at their peak degree of ripeness (Penner, 1982:1-8).

Some perishable raw vegetables like red and green peppers and onions require very limited preparation for freezing. The main action is washing, after which they can be frozen satisfactorily without heat treatment. The washing reduces the microbiological count prior to freezing. Fresh produce contains chemical compounds called enzymes (lipoxidase, peroxidases and catalase) that cause the loss of colour, loss of nutrients, flavour changes, and colour changes in frozen fruits and vegetables. These enzymes must be inactivated to prevent such reactions from taking place (Penner, 1982:1-8)

The blanching process inactivates enzymes in vegetables. Blanching is the exposure of the vegetables to boiling water or steam for a brief period of time. The vegetable must then be rapidly cooled in ice water to prevent it from cooking. Blanching also helps to destroy microorganisms on the surface of the vegetable and to make some vegetables, such as broccoli and spinach, more compact (Penner, 1982:1-8).

The heat of blanching is also effective in killing many of the microorganisms that are present even after washing. Blanching sets chlorophyll that gives the bright green colour seen in frozen vegetables. When greens are blanched, they must be dispersed vigorously to ensure that heat penetrates the greens. If the greens are clumped, heat distribution will be impeded. Unfortunately, bacterial recontamination

occurs very quickly after blanching when vegetables are frozen commercially. Very large quantities of cold water in an air-conditioned facility helps to keep the temperature low enough to retard bacterial growth while the vegetables are packaged and frozen. The net result of commercial efforts in processing frozen vegetables has been a great reduction in bacterial counts and frozen vegetables are not likely causes of food borne illnesses (McWilliams, 2001).

A quick-freeze technique is used to freeze produce. This process preserves the food's nutrients. When fresh fruits and vegetables are exposed to light and air, the vitamins in the food break down over time. Fresh produce that has been on the shelf long past its harvest date may actually be lower in nutrients than food that is frozen immediately after picking. The highest levels of nutrients can be found in fresh fruits and vegetables that are in season. Otherwise, frozen varieties are a good choice. Using frozen produce is a good way to get a wide variety of important fruits and vegetables into a balanced diet (McWilliams, 2001).

### **2.6.3 Bacteria and parasites**

Freezing keeps food safe by slowing the movement of molecules, causing microbes to enter a dormant stage. Freezing preserves food for extended periods because it prevents the growth of microorganisms that cause both food spoilage and foodborne illness (Ehler, 2003).

Freezing kills most bacteria and some of those that survive, die after frozen storage. However, some freeze-resistant bacteria remain viable even though their reproduction is retarded greatly. Freezing kills almost 60 % of the bacteria in a food and still more are killed during storage (McWilliams, 2001).

Freezing to 0° F inactivates any microbes, bacteria, yeasts and molds present in food. Once thawed, however, these microbes can again become active, multiplying under the right conditions to levels that can lead to food borne illness. Since they will then grow at about the same rate as microorganisms on fresh food, thawed items must be handled as any perishable item would be. Thorough cooking will destroy bacteria (Ehler, 2003).

Trichina and other parasites can be destroyed by sub-zero freezing temperatures. However, very strict government-supervised conditions must be met. It is not recommended to rely on home freezing to destroy trichina. Thorough cooking will destroy all parasites (Ehler, 2003).

### **2.6.4 Food quality**

Freshness and quality at the time of freezing affect the condition of frozen foods. If frozen at peak quality, foods emerge tasting better than foods frozen near the end of their useful life (Ehler, 2003).

## 2.7 The effect of vegetable freezing on micronutrients

The true mechanism of health benefits to be derived from eating vegetables and fruit is likely due to synergies between many nutrients (Van Duyn & Pivonka, 2000:1511-1521). Table 2.1 gives a summary of the proposed mechanisms of action of a variety of phytochemicals found in vegetables (Van Duyn & Pivonka, 2000:1511-1521; Craig & Beck, 1999:78-84). Research on the effect of processing on all the different phytochemicals is limited and only the available results will be discussed below.

Table 2.1 A variety of phytochemicals and their proposed mechanisms of action (Compiled from Van Duyn & Pivonka, 2000:1511-1521 and Craig & Beck, 1999:78-84)

Class/component	Source (not an exhaustive list)	Potential benefits
<b>Anthocyanins</b>	Strawberries, cherries, cranberries, raspberries, blueberries, grapes, black currants, radishes	Antioxidant; inhibit LDL oxidation; inhibit platelet aggregation
<b>Carotenoids</b>		
Alpha-carotene	Carrots	Antioxidant; inhibits cell proliferation
Beta-carotene	Orange coloured vegetables and fruit such as: carrots, sweet potatoes, squash, pumpkin, canteloupe, mango, apricot and spinach	Antioxidant; inhibits cell proliferation; helps in differentiation of normal epithelial cells
Lutein	Green vegetables such as spinach, chard, asparagus, peas	Antioxidant; protects against cataracts and macular degeneration
Lycopene	Tomatoes and tomato products, watermelon, pink grapefruit, guava	Antioxidant; may reduce risk of prostate cancer; may also protect against breast and cervical cancer; decreases LDL oxidation
Zeaxanthin	Citrus, corn	Antioxidant; protects against cataracts and macular degeneration
<b>Fibre</b>		
Insoluble	Fruit and vegetables	Protects against diverticulosis
Soluble	Fruits and vegetables	Binds and dilutes carcinogenic substances; helps control blood sugar levels and cholesterol levels
<b>Flavonoids</b>	Most fruit and vegetables	Antioxidants; may reduce cell proliferation; inhibit blood clot formation; anti-inflammatory action
<b>Glucosinolates/indoles</b>	Broccoli, bok choy, cauliflower, Brussels sprouts, cabbage, kale, mustard greens, rutabaga, turnip	Protects against oestrogen-promoted cancers; induces protective enzymes
<b>Phytoestrogens</b>		
Isoflavones	Soy beans	Protect against breast and prostate cancer
Lignans	Vegetables	Antioxidant; may block or suppress cancerous changes; lowers LDL cholesterol, total cholesterol and triglycerides
<b>Saponins</b>	Soy beans, lima beans, pinto beans, chickpeas, kidney beans, lentils and split peas	May lower LDL cholesterol; contain anticancer enzymes
<b>Sulfides</b>		
Diallyl sulfide	Onions, garlic, leeks, scallions, olives	Stimulates anticancer enzymes; detoxifies carcinogens; antibacterial activity may inhibit conversion of nitrate to nitrite, reducing formation of nitrosamines
Allyl methyl trisulfide	Broccoli, bok choy, cauliflower, Brussels sprouts, cabbage, kale	Stimulates anticancer enzymes; detoxifies carcinogens; antibacterial activity may inhibit conversion of nitrate to nitrite, reducing formation of nitrosamines

Dithiols	Broccoli, bok choy, cauliflower, Brussels sprouts, cabbage, kale	Increase activity of enzymes involved in detoxification of carcinogens
<b>Vitamins and minerals</b>		
Folate	Asparagus, broccoli, Brussels sprouts, peas, spinach, orange juice, legumes	Inadequate intake may lead to chromosomal damage at sites relevant to specific cancers; may lead to reduced methylation of DNA which may permit loss of normal controls on the expression of genes
Vitamin C	Broccoli, Brussels sprouts, peppers, citrus, berries	Antioxidant; reduces nitrite, thereby reducing formation of nitrosamines
Potassium	Most fruit and vegetables	May prevent or control hypertension and subsequent risk of stroke and heart disease

### 2.7.1 Antioxidants

Compared with most foods, vegetables contain a very high total antioxidant activity (Hunter & Fletcher, 2002:399-406). This is probably highly significant in explaining the beneficial effects of vegetable consumption that have been observed in many epidemiological studies. There is a growing body of evidence suggesting that compounds with antioxidant activity play a major role in explaining the benefits of vegetable consumption (Hunter & Fletcher, 2002:399-406).

According to Leather (1995:10-17), researchers believe that about 25 per cent of major cancers in Europe could be prevented by dietary change. Some intervention studies used supplements of antioxidants and also reported a protective effect. It was found in the Nurses' Health Study and the Health Professional's Follow-up Study in the USA, that there was a reduction in cardiovascular disease in people given vitamin E supplements (Stampfer *et al.*, 1993:1444-1449; Rimm *et al.*, 1993:1450-1456). Men showed a 37% and women a 41% reduction in risk for cardiovascular disease (Stampfer *et al.*, 1993:1444-1449; Rimm *et al.*, 1993:1450-1456).

Antioxidants are those compounds that protect biological systems against the harmful effects of excessive oxidations (Leather, 1995:10-17). This imbalance (oxidative stress), in which free radicals cause damage, is present in many human disease processes. Examples of clinical conditions related to free radical damage include: cancer, cardiovascular disease, cataracts, age-related macular degeneration and pancreatitis. Degenerative and chronic diseases are seldom caused by one factor alone, but usually by a synergistic mechanism such as smoking and something else, perhaps genetic susceptibility. It was found that adequate levels of antioxidants, like vitamin C, vitamin E and beta-carotene, seem to contribute towards the delay in manifestation of these diseases and are very important in maintaining good health (Leather, 1995:10-17).

Because vegetables and other natural products contain many hundreds of compounds with potential antioxidant activity, it is impractical to quantify all of these individually. However, techniques have been developed that attempt to determine the total antioxidant activity of a specific food (Hunter & Fletcher, 2002:399-406). Hunter and Fletcher (2002: 399-406) found that although it is not clear whether analytical estimates of total antioxidant activity predict beneficial effects after consumption, these

methods do allow a comparison to be made between different vegetables and between different methods of storage, processing and cooking.

Many studies on antioxidants in food have concentrated on the measurement of specific antioxidants in vegetables and fruit (Hunter & Fletcher, 2002:399-406). However, the total antioxidant activity of vegetables has been demonstrated in a few publications and the results of these studies show that, compared with other foods, vegetables are a rich source of compounds with antioxidant activity (Hunter & Fletcher, 2002:399-406).

Previous studies on antioxidant activity have mostly been carried out on extracts of unprocessed and uncooked samples of vegetables. However, after harvest and before consumption, vegetables may be stored for varying periods of time and may be processed and prepared under a wide variety of conditions. Many vegetables are consumed after prolonged periods of storage and after a variable degree of processing and cooking. It was found that the conditions of storage, processing and preparation have very significant effects on the level of ascorbate in vegetables (Hunter & Fletcher, 2002:399-406).

In a study done by Hunter & Fletcher (2002:339-406), commercially available samples of fresh, frozen, canned and jarred vegetable products were purchased from supermarkets. In addition, antioxidant activities were measured in peas grown at Unilever R&D Colworth (Sharnbrook, Bedfordshire, UK) and sampled at harvest maturity. After harvest, samples of peas and spinach were stored in plastic bags at 20 °C or at 4 °C or were blanched and frozen. The blanching and freezing was done by using an approximation of commercial conditions. The peas were cooked for 85 seconds at  $97\pm 1$  °C, then cooled with cold water for 90 s and frozen at -30 °C for 40 min. The spinach was cooked for 90 seconds at  $97\pm 1$  °C, then cooled with cold water for 90 s and frozen at -30 °C for 40 min. Frozen samples were then stored in plastic bags at -20 °C (Hunter & Fletcher 2002:339-406).

It was found that the antioxidant activity in both ambient and chilled samples of spinach declined with time of storage. Blanching caused a loss of approximately 50% and thereafter the activity in frozen samples remained constant. In peas, the activity of samples stored at 4 and at 20 °C remained approximately constant until 7 days after harvest. Blanching caused a loss of approximately 20% and thereafter the activity in frozen samples remained constant. In both peas and spinach (ambient, chilled and frozen), the lipid-soluble antioxidant activity remained stable for up to 21 days of storage at either 4 or 20 °C. There was also no effect of blanching and freezing. In both peas and spinach, the ascorbate content declined on being chilled and ambient. The ascorbate content in spinach was not detectable in ambient samples after 3 days and in chilled samples after 21 days (Hunter & Fletcher, 2002:399-406). Hunter & Fletcher (2002:399-406) also found that although some ascorbate remained in peas stored at ambient and chilled conditions, levels declined to lower than found in frozen peas. Hunter & Fletcher (2002:399-406) concluded that a substantial proportion of the total antioxidant activity of a vegetable

may be lost during storage after harvest and that storage at typical chill temperature (4 °C) may reduce the rate of loss.

A further large proportion of antioxidant activity (particularly water-soluble activity) may also be lost when vegetables are commercially processed. However, the losses caused by blanching and freezing were relatively small, particularly in peas. Also, losses of ascorbate have been shown to be significantly higher in canned and jarred vegetables compared with frozen vegetables (Hunter & Fletcher, 2002:399-406).

In measuring the total antioxidant activity in vegetables processed under different conditions, Hunter & Fletcher (2002:399-406) demonstrated that frozen vegetables have similar antioxidant activities to the equivalent vegetables purchased fresh from supermarkets and much higher levels compared with canned and jarred vegetables.

### 2.7.2 Flavanoids

In the study done by Hunter & Fletcher (2002:399-406), flavanoids have not been detected in significant quantities in peas, and, therefore, the measurements of total polyphenols were only made in spinach. They have extracted 6.07 mg of total polyphenols from 1 g of frozen spinach that gave an antioxidant activity of 0.783 mmol·g<sup>-1</sup> of solid, equivalent to 4753 nmol·g<sup>-1</sup> of spinach tissue.

According to Amitori and Herrmann (in Hunter & Fletcher, 2002: 399-406), it is known that 1 g of spinach contains approximately 0.150 mg of flavanoid-*O*-glycosides and 0.45 mg of hydroxycinnamate esters and these compounds would form at least 10% of the 6 mg of polyphenols extracted from frozen spinach. Given that the unknown water-soluble antioxidant value for frozen spinach is 3315±578 nmol·g<sup>-1</sup> and the total polyphenol value is 4753 nmol·g<sup>-1</sup>, this would suggest that these compounds could make up all of the unknown activity within experimental error. However, as the form (aglycone or glycoside) in which flavanoids are absorbed by the human body is still debated, their contribution to the antioxidant activity *in vivo* cannot be determined. However, Bergman *et al.* (in Hunter & Fletcher, 2002:399-406) state that spinach flavanoid-*O*-glycosides have been characterised and shown to have antioxidant activity *in vitro*. There is now growing evidence for a correlation between dietary flavanoids and the reduction of serious diseases, such as coronary heart disease (Hertog *et al.*, 1993, in Hunter & Fletcher, 2002:399-406), cardiovascular disease (Yochum *et al.*, 1999, in Hunter & Fletcher, 2002:399-406) and lung cancer (le Marchant *et al.*, 2000 and Knekt *et al.*, 1997, in Hunter & Fletcher, 2002:399-406). Therefore, a diet rich in flavanoids could be advantageous to health (Hunter & Fletcher, 2002:399-406).

### 2.7.3 Carotenoids

Numerous epidemiological studies have shown consistently significant associations between dietary intake, blood levels of carotenoids (particularly β-carotene) and the incidence of degenerative diseases, including several types of cancer and cardiovascular diseases (Thane & Reddy, 1997:58-65).

Fruit and vegetables are abundant sources of carotenoids and are consumed widely and in varying amounts. Both food groups, but vegetables in particular, are subjected to different types of processing prior to consumption. Although consumption of fresh, unprocessed fruit and vegetables is widely advocated, it may not always be realistic or possible, owing to reasons of cost, availability and seasonality. Processing is, therefore, necessary and, in many ways, desirable. The intake of fresh produce may be complemented by processed forms, not only to increase overall consumption but also to enable regular intake throughout the year (Thane & Reddy, 1997:58-65).

Carotenoids are not nutritionally essential, but they do have unique and important roles in the human diet. An important function of some carotenoids is their role as vitamin A precursors and their individual structures determining biopotency. Vitamin A deficiency is widespread in developing countries and leads to impaired cellular functioning, xerophthalmia, growth retardation, increased susceptibility to infection and, sometimes, blindness (Thane & Reddy, 1997:58-65).

Reporting on the effects of processing on carotenoids in vegetables has been very extensive. This may be due to their being a much richer source of carotenoids,  $\beta$ -carotene in particular. Most vegetables are processed prior to consumption. Processing may be minimal or more extensive, involving procedures such as washing, peeling, cutting, blanching, addition of processing chemicals, drying (dehydration), freezing and canning. All have a potential impact on carotenoid form and content (Thane & Reddy, 1997:58-65).

Blanching has a key influence on the final vitamin content of vegetables. There are different types of blanching which include water, steam, vacuum-steam, in-can, microwave and hot-air. Water blanching (e.g. 75 - 95°C for 1 - 10 minutes) is most commonly employed as capital and running costs are relatively low. Because water is used, the addition of processing aids, such as sulphite to control vegetable colour, may be added. When sulphite (acting as an antimicrobial agent and inhibitor of enzymes and nitrosamine formation) is added, reduced losses of carotenoids, as well as vitamin C have been seen. Vitamin losses through leaching are, however, significant, and so steam blanching is also employed. Blanching can cause 5 - 13% loss of carotenoids. As carotenoids are fat-soluble, leaching is not a problem and losses are small. Peroxidase and lipoxygenase enzymes that are involved in carotenoid destruction can be inactivated by blanching (Thane & Reddy, 1997:58-65).

Thane & Reddy (1997:58-65) found that freezing, particularly rapid freezing, does not alter the nutritional value of the product. Losses in more labile vitamins occur during preparative stages prior to freezing, particularly blanching and during frozen storage. During freeze-drying, stereoisomers of carotenoids are not formed, although total carotenoid values for freeze-dried carrots have been reported to be somewhat lower than for fresh carrots (Sweeney & Marsh, 1971:238-243). Losses of  $\beta$ -carotene in frozen vegetables may be less than 20% over a two year storage period (Thane & Reddy, 1997:58-65).

Thane & Reddy (1997:58-65) also found that the type of packaging (e.g. cans, glass, plastic) used for processed fruits and vegetables can influence product quality and carotenoid losses during storage. For example, minimally processed fruits and vegetables can be packaged in various ways such as aerobic, modified atmosphere, controlled atmosphere and vacuum packaging. With aerobic packaging, the produce is exposed to oxygen and, therefore, carotenoid content may be reduced through oxidation. Therefore, other forms of packaging may help to limit carotenoid losses. Shrink-wrapping is also employed and has been shown to be effective in retarding moisture loss, although its effect on carotenoids has not been documented (Thane & Reddy, 1997:58-65).

The carotenoid content of processed fruit and vegetables depends on:

- their quantity in the original raw foods
- the extent and nature of processing (industrial and domestic)
- the storage conditions
- whether vitamin losses have been restored post-processing (Thane & Reddy, 1997:58-65).

Carotenoids, being fat-soluble, are not prone to water leaching (on boiling) but they are relatively unstable to oxygen (on drying or when stored in open containers), light (such as exposure to fluorescent lighting in display cabinets) and heat (from cooking), with losses in the range 0–40% (Thane & Reddy, 1997:58-65). Therefore, maximum carotenoid retention may be obtained by keeping these destructive factors to a minimum. Processing may beneficially increase unit content and bioavailability of carotenoids, although isomerization may be induced with consequent loss of provitamin A activity. This could exacerbate matters in developing countries where vitamin A deficiency is prevalent. With regard to non-provitamin A carotenoids (lycopene, lutein), processed fruits and vegetables may even have advantages over their raw forms. They enable all-year round availability and a greater variety of forms for consumption. When vegetables are optimally processed, packaged and stored, they can be even more healthful than their fresh counterpart (Thane & Reddy, 1997:58-65).

## **2.8 Consumers' attitudes towards fresh versus frozen vegetables**

Patterson *et al.* (1990:1443-1449) found that when consumers make choices about food, they select what they eat on the basis of criteria other than nutritional value. Also in the 1990s, more people were eating away from home and consuming more combination foods like pizza and more fat-free items, though not necessarily fewer kilojoules (Patterson *et al.*, 1990:1443-1449). According to Klein (1997:1-15), data from USDA (United States Department of Agriculture) surveys as well as other polls conducted by health organizations, indicate that Americans know about healthy eating and can define nutritional concerns. Unfortunately most fail to apply these principles in selecting a healthy diet. She states that despite what government and health agencies advocate, fruit and vegetable consumption is not

increasing substantially. Consumers seemed to believe that fresh fruits and vegetables provide more vitamins and fibre than their processed counterparts (Klein, 1997:1-15; Powers, 1996). Klein (1997:1-15) also found that processing is thought to destroy nutrients and add preservatives, indicating a lack of understanding about how foods are handled for freezing.

People seem to have the notion that processed fruits and vegetables don't have the nutritional values of fresh, but by the time fresh produce has traveled from field to truck to retail shelf to the dinner table, a couple of weeks can pass (Klein, 1997:1-15; Powers, 1996). Klein (1997:1-15) states that fresh produce may be picked at its peak of nutrition, but during transit time, it is gradually dying, so it has used up the nutrients through its own metabolism. In contrast, frozen fruits and vegetables don't have that problem. Klein (1997:1-15) states that the science behind freezing "in" the nutrients of vegetables is that by blanching first, the enzymes that cause oxidation of vitamins are inactivated.

According to Brunnhofer (2003) of the Austrian Consumers' Association, tests show that the techniques used to grow crops out of season can leave them tainted with chemicals, while the delay in getting them to the shops reduces their nutritional value as they degrade. He continues that no pesticides could be found in many frozen products and only very low levels of nitrates (as little as 100 times less than the permitted levels) were found. He explained that when summer crops are grown in winter, higher nitrate levels are needed to produce growth, so imported fresh vegetables have more residues. Nutrients such as vitamin C are also lost every day if they are transported from faraway places. He continues that frozen vegetables, on the other hand, are grown in their normal season and are processed quickly so all their goodness is preserved. (Brunnhofer, 2003).

According to the FDA (Food and Drug Association) talk paper (1998), the FDA has issued a new rule allowing the use of the term "healthy" on the labels of certain frozen and canned fruits and vegetables and enriched cereal grain products (FDA, 1998). This new rule was designed to encourage greater use of foods whose consumption is recommended in the U.S. Dietary Guidelines as important for the maintenance of good health (FDA, 1998).

The FDA's first definition of the implied nutrient content claim "healthy," published in May 1994, stated that the descriptor could be used on an individual food if it was low in fat and saturated fat, met limits for sodium and cholesterol and contained at least 10 % per serving of the Daily Value of one or more of the following nutrients: vitamin A, vitamin C, calcium, iron, protein and fibre (FDA, 1998).

Raw fruits and vegetables can contribute significantly to a healthy diet and the rule, therefore, specified that raw produce could be labeled "healthy" without meeting the 10% nutrient contribution requirements, provided it met the other requirements (FDA, 1998).

After this rule was published, the American Frozen Food Institute (AFFI) and the National Food Processors Association petitioned FDA for the same exemption from the 10% nutrient contribution requirement for processed single-ingredient fruits and vegetables on the basis of evidence that such products are nutritionally equivalent to raw produce (FDA, 1998).

The FDA, in response, published in February 1996 a proposed rule tentatively concluding that the term "healthy" should be allowed on single ingredient frozen fruits and vegetables and certain enriched cereal-grain products (FDA, 1998). During the comment period the agency received approximately 100 generally supportive letters from industry, trade organizations, consumer interest groups and academia. In the final rule the FDA is allowing the use of the term "healthy" for frozen or canned fruits and vegetables that do not contain ingredients that would change the nutrient profile (FDA, 1998).

## **2.9 Conclusion**

The current evidence collectively demonstrates that fruit and vegetable intake is associated with improved health and reduced risk of major diseases. Although many consumers are aware of the health benefits of eating plenty of vegetables and fruits every day, many factors and barriers to increase the consumption thereof have been identified in the literature. Although frozen vegetables might be a possible solution for some of these barriers, consumers in other countries tend to have negative attitudes towards the freezing of vegetables. Therefore, a large frozen food production company, McCain, approached the Nutrition Research Group of the Potchefstroom University to determine the attitude of South African consumers in metropolitan areas towards frozen vegetables. This study was part of a larger marketing research project in cooperation with the food industry. Most of the statements in the questionnaires were formulated by the food industry partners. MARKINOR, a marketing research company, administered the questionnaires. The results on frozen vegetables will be summarised in the manuscript in the next chapter, prepared for the consumer science journal. The author's instructions follow immediately after the abstract in Chapter 3.

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## Chapter 3: Article

### TITLE PAGE

**Consumers' attitudes regarding the link between frozen and fresh vegetables and health and the attributes of frozen vegetables.**

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### **OPSOMMING**

Groente en vrugte speel 'n baie belangrike rol in die voorkoming van verskeie siektes onder andere kanker en koronêre hartvatsiektes. Daar is gevind dat die inname van groente en vrugte in Suid-Afrika heelwat minder is as die aanbevole daaglikse hoeveelheid. Verskeie redes en struikelblokke word aangevoer waarom voldoende hoeveelhede nie ingeneem word nie. Van die struikelblokke is die bederfbaarheid van groente, die relatief lang voorafbereidingstyd en ongereelde beskikbaarheid van vars groente. Gevriesde groente kan egter nuttig aangewend word omdat dit lank gestoor kan word en om die rede geredelik beskikbaar is. Uit die literatuur is dit egter duidelik dat verbruikers in ander lande 'n negatiewe houding oor gevriesde groente het. Dit spruit hoofsaaklik uit oningeligtheid oor die bevroingsproses en ander aspekte van gevriesde groente. Die doel van hierdie studie was om vas te

stel wat verbruikers in Suid-Afrika se houdings ten opsigte van gevriesde teenoor vars groente en gesondheid is. Eenduisend negehoenderd sewe-en-negentig ewekansig verkose stedelike verbruikers het vroege antwoorde ten opsigte van hul houdings teenoor gevriesde en vars groente. Die volgende produkeienskappe was gebruik om die houdings van verbruikers vas te stel: voorkoms, smaak, gerief, keuse, rakleefyd (vars groente) en voedingswaarde. Deur statistiese analises is verbruikers gestratifiseer in verskillende veranderlikes naamlik geslag, ouderdomsgroepe, lewenstandaardvlak, ras en vlak van opvoeding en houdings. Die resultate dui daarop dat verbruikers oor die algemeen baie negatief ingestel is teenoor gevriesde groente. Daar is onder andere gevind dat die ouderdomsgroep 61+, Indiërs en mans meer negatief teenoor gevriesde groente as ander groepe was. Daar was egter praktiese en statistiese betekenisvolle verskille gevind tussen die verskeie lewenstandaard groepe, veral ten opsigte van die gerieflikheid van gevriesde groente. Verbruikers in die laer lewenstandaardvlak (LSM 2) was meer negatief oor gevriesde groente ten opsigte van geriefsvoedsel as die hoë lewenstandaardvlak (LSM 10). Bykans 75% van alle verbruikers het aangedui dat hulle nooit bevrore groente eet nie. Slegs 1% van die verbruikers in LSM 2 besit 'n yskas/vrieskas. 'n Ontstellende 26% van alle respondente het aangedui dat hulle nie oortuig is dat groente gesond is nie. Hierdie inligting behoort deur gesondheidswerkers gebruik word om spesifieke groepe te teiken om sodoende die inname van gevriesde groente en daardeur die totale daaglikse inname van groente te verhoog. Verdere navorsing is nodig om Suid-Afrikaanse verbruikers se houding teenoor gevriesde groente en maniere waarop die gebruik daarvan bevorder kan word vas te stel. Dit word sterk aanbeveel dat geskikte meetinstrumente ontwikkel word vir die bepaling van die kennis en houding van Suid-Afrikaneers ten opsigte van die inname van groente en vrugte en die vermoë van individue om hul gesondheid te bevorder.

## **ABSTRACT**

Vegetables and fruit appear to confer protection against various diseases, but most adults in South Africa eat substantially less than the recommended amounts. Many barriers and factors that influence vegetable consumption have been identified in the literature. One major barrier is the perishability of vegetables. Frozen vegetables can be a useful way in encouraging greater intakes. Some consumers are, however, of the opinion that processing destroys nutrients to a large extent. There is, therefore, a lack of understanding of the freezing process. Research on the attitudes of consumers towards frozen vegetables in South Africa is limited.

**Objective:** The purpose of this study was to determine the attitudes of consumers regarding the link between frozen and fresh vegetables and health and the attributes of frozen vegetables.

**Subjects/Setting:** One thousand nine hundred and ninety seven South African respondents, representative of the four major race groups of South Africa (whites, blacks, coloureds and Indians) were

randomly chosen from metropolitan areas from the nine provinces in South Africa. Questionnaires, existing of 17 food-related sections, including subsections on vegetables and health, were designed by researchers in co-operation with business partners. MARKINOR, a market research company, was contracted to collect the data. Respondents were questioned regarding their attitudes towards the link between frozen and fresh vegetables and health.

**Statistical analysis performed:** The quantitative data produced by the survey was analysed by using the Statistica®-programme in order to generate the relevant tabulations, descriptive statistics and statistical tests.

**Results:** Overall, the attitudes of consumers towards frozen vegetables were found to be negative. Practical and statistically significant attitude differences towards frozen vegetables were found between most variables. Results from this study revealed that different levels of education, age and gender do not have a big influence on consumer's attitudes towards frozen vegetables. However, practical and statistically significant differences were found between the various LSM (Living Standards Measure) groups, especially with regard to the convenience of frozen vegetables. Results also indicated that Indians, the age group 61+ and males were the most negative towards frozen vegetables. Almost 75% of all consumers indicated that they never eat frozen vegetables. Only 1% of consumers in the LSM group 2 own a fridge/freezer. An alarming 26% of all consumers indicated that they are not convinced that vegetables are healthy.

**Application/Conclusions:** Nutrition professionals should use these findings to target messages in health-promotion programmes to increase the overall consumption of vegetables. The use of frozen vegetables by consumers with frozen storage facilities should be promoted aggressively. Consumers also need practical advice on how to overcome the barriers to dietary change. Nutrition counseling efforts should also be aimed specifically at increasing frozen vegetable consumption among targeted subgroups, particularly Indians, males and the age group 61+. It is strongly recommended that suitable measuring instruments be developed for assessing the knowledge and attitude of South Africans towards vegetable and fruit consumption and the ability of individuals to improve their health. The results of this study may prove to be very useful in this regard.

## **SEARCH WORDS**

Frozen vegetables, attitudes, South Africans, shelf life, convenience, taste, choice, appearance, LSM, gender, age, race, education

# **JOURNAL OF FAMILY ECOLOGY AND CONSUMER SCIENCES GUIDELINES FOR AUTHORS**

## **Preparation and technical detail of manuscripts**

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Each separate part of the manuscript begins on a new page. Arrange the different parts as follows:

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## **7. Tables**

Well-planned tables contribute to the value of an article. In view of the relatively high cost associated with publishing tables, only essential information should be included in support of the text. Each table has to be typed on a separate page and as far as possible in 1,5 or double spacing. Tables have to be numbered and given headings that reflect the content:

### **TABLE 1: RANKING OF THE FIVE MOST IMPORTANT ACTIVITIES AND RESPONSIBILITIES OF HOME ECONOMISTS**

Each column should have a heading and should contain measurements of the same unit. No full stops are used after headings. Note the use of a decimal comma. Abbreviations (explained in a footnote under the table) may be used as space is limited. In the text a table is referred to by its number: Table 1 or (Table 1). Indicate placement of the table in the text as follows:  
Place Table 1 here Please look at other specific technical details about typing tables, and for examples of tables elsewhere on the Web site.

## **8. Figures**

Carefully selected graphs, sketches or other graphic material that could facilitate understanding of the text. Bear in mind that figures have to fit into one or two columns of the Journal. Detail may be lost in the process of scaling down graphic material to fit into one or two columns. Design the graphics with the width of a column (75 mm) or page (170 mm) in mind. The largest size graphics is 225 mm x 170 mm. Text-based figures should be constructed in Microsoft Office PowerPoint 97/2000 and saved as a PowerPoint Presentation (.ppt format). Use Arial type-face as the base font for all text-based figures. Charts should be constructed in Microsoft Office Excel 97/2000 and saved as an Excel spreadsheet (.xls format). Use Arial type-face as the base font for all text in charts.

Graphical material accompanying the text should be in a format that is ready for typographical processing. Additional fees will be charged for editing of incorrect graphical material. Photographs or maps should be clear, with sufficient contrast. Protect photographs and maps between two sheets of cardboard. Do not attach photographs or maps to the protective cardboard or manuscript. Identify photographs and maps by writing in soft pencil on the back near the edge. All photographs and graphic material are referred to as figures. Most of the conventions for tables apply to figures as well, except that figures have subscripts:

**FIGURE 1: FACTORS THAT INFLUENCE THE FORMATION OF HABITUAL EATING HABITS**

In the text figures are referred to by their numbers: Figure 1 or (Figure 1). Indicate placement of the figure in the text as follows:

Place Figure 1 here

## INTRODUCTION

Vegetables and fruit appear to confer protection against various diseases (Hyson, 2002), but most adults in South Africa eat substantially less than the recommended amounts (Love & Sayed, 2001). Since vegetables and fruits supply many similar nutrients, their consumption is often tracked as a composite. Many barriers and factors that influence vegetable consumption have been identified in the literature. One major barrier is the perishability of vegetables. Consumers also find it inconvenient to prepare fresh vegetables (Pollard *et al.*, 2002; Cohen *et al.*, 1998; Cox *et al.*, 1996). This can lead to a reduction in their intake of vegetables generally. Frozen vegetables (which are already washed, peeled and sliced or diced) can be a useful way in encouraging greater intakes (Klein, 1997:2). Despite what government and health agencies advocate, fruit and vegetable consumption is not increasing substantially (Klein, 1997:2, Love & Sayed, 2001) This might be because consumers seem to believe fresh fruits and vegetables provide more vitamins and fibre than their processed counterparts (Klein, 1997:2; Powers, 1996). Klein (1997:2) also found that processing is thought to destroy nutrients and add preservatives. There is, therefore a lack of understanding of how foods are handled for freezing and the freezing process itself.

When fresh fruits and vegetables are exposed to light and air, the vitamins in the food break down over time. Fresh produce that has been on the shelf long past its harvest date may actually be lower in nutrients than food that is frozen immediately after picking. The highest levels of nutrients can be found in fresh fruits and vegetables that are in season. This is also the time when vegetables are frozen commercially. Using frozen produce is an excellent way to include a wide variety of important fruits and vegetables into a balanced diet (McWilliams, 2001:472).

Research on the attitudes of consumers towards frozen vegetables in South Africa is very limited and no current publications could be located. The purpose of this study was to determine the attitudes of consumers regarding the link between frozen and fresh vegetables and health and the attributes of frozen vegetables.

## AIMS OF THE ARTICLE

The overall purpose of this research was to investigate the attitudes of urbanised adults towards frozen vegetable consumption.

In more specific terms, the objectives of this study were:

- To establish whether different living standards have an influence on the consumers' attitudes towards frozen vegetables
- To establish if various age groups had different attitudes towards frozen vegetables
- To determine whether education played an important role in consumers' attitudes towards frozen vegetables
- To determine whether different race groups had different attitudes towards frozen vegetables
- To establish whether there was a difference in attitudes towards frozen vegetables between men and women.

The variables were subdivided into the groups depicted in Table 1. These were gender, living standard measurement (LSM), age, race and education.

**TABLE 1: VARIABLES AND THEIR SUBGROUPS USED IN THIS STUDY**

Variable	Subgroups									
<b>GENDER</b>	Men					Women				
<b>LSM</b>	2	3	4	5	6	7	8	9	10	
<b>AGE</b>	18 – 30		31 - 45			46 – 60			61 +	
<b>RACE</b>	Black		White			Coloured			Indian	
<b>EDUCATION</b>	Less than high school					More than primary school				

LSM (Living Standard Measure)

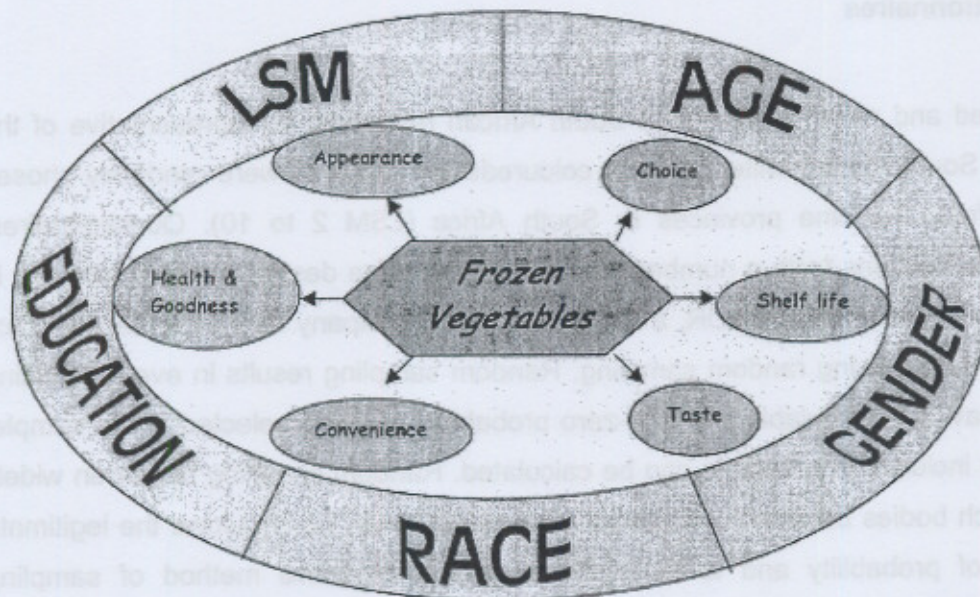
## RESEARCH PERSPECTIVE

Important elements in a consumer's decision-making process are attitudes towards a product or service. Consumer attitudes are probably the most considered concept in the study of consumer behaviour. During the process of attitude formation towards a specific product, the cues and signals of value regarding that product's attributes are of paramount importance. When there is a positive attitude towards a product the likelihood of a person buying the product is favourable (Du Plessis *et al*, 1994:17).

Studies on attitudes can help health professionals to formulate effective objectives for programmes and to develop relevant techniques for health education (Foley *et al.*, 1979: 13 -18).

The following specific product characteristics were used in this study to determine the attitudes of consumers: convenience of preparation, shelf life (of fresh vegetables), taste, choice, appearance and health/nutritional value of frozen vegetables. These characteristics were compared between subgroups within a variable.

Figure 1 demonstrates the different product characteristics and the five variables that were investigated in this study.



**FIGURE 1: ATTITUDES OF CONSUMERS TOWARDS FROZEN VEGETABLES COMPARED BETWEEN VARIABLES.**

#### **DESCRIPTION OF KEY CONCEPTS**

The following definitions apply to terms used in the context of this research.

- **Attitude**

Attitude may be defined as a positive or negative feeling towards an object, issue or person (Foley *et al.*, 1979:13-18). Attitudes are formed by personal usage or trust in the attitudes of other influential users (beliefs may be formed without product experience) (Sargeant & West, 2001:71).

- **Living standards measure**

The Living Standards Measure (LSM) divides the population into ten LSM groups, 10 (highest) to 1 (lowest). The LSM is a unique means of segmenting the South African market. It cuts across race and other outmoded techniques of categorising people and instead groups people according to their living standards using criteria such as degree of urbanisation and ownership of cars and major appliances (Haupt, 2003). Consumers in LSM 1 (rural) were not included in the study.

## **RESEARCH DESIGN**

### **Data collection and questionnaires**

One thousand nine hundred and ninety seven adult South African respondents, representative of the four major race groups of South Africa (whites, blacks, coloureds and Indians) were randomly chosen from metropolitan areas from the nine provinces in South Africa (LSM 2 to 10). Questionnaires, consisting of 17 food-related sections (with a number of subsections), were designed by researchers in co-operation with business partners. MARKINOR, a market research company conducted face to face interviews and collected the data using random sampling. Random sampling results in every sampling unit in a finite population having a calculable and non-zero probability of being selected in the sample. The chance of a unit being included in a sample can be calculated. Random sampling has been widely adopted by leading research bodies because of its sound theoretical basis, which allows the legitimate use of the mathematics of probability and is the only completely objective method of sampling populations (Chrisnall, 2001:99). Four of the 17 food-related questionnaires contained information on vegetables. These included a questionnaire to determine the attitudes towards vegetables (fresh, frozen and canned), another questionnaire on the beliefs about vegetables and health, a questionnaire on the frequency of vegetable consumption and a questionnaire on various preparation techniques. One of these questionnaires was used to elicit information regarding the attitudes of consumers towards the link between fresh and frozen vegetables and health. Table 2 contains the statements used from this questionnaire. The data of 1997 respondents have been used for the analysis.

**TABLE 2: STATEMENTS USED FOR STATISTICAL ANALYSIS**

Statements	
F6_08	I believe that frozen vegetables are the healthiest choice
F6_09	I believe that fresh vegetables are the healthiest choice, depending on how long they have been on the shelf
F6_15	I think that frozen vegetables taste better than fresh vegetables
F6_17	Life is so busy, so I use frozen vegetables to make things easier for me and to save time
F6_18	I believe that frozen vegetables are the healthiest choice, because the goodness has been locked in
F6_19	Frozen vegetables look more appetizing than fresh vegetables when cooked.

To determine whether consumers with different age, gender, education level, LSM level and race groups perceived fresh and frozen vegetables differently in terms of six identified product attributes, respondents were given the choice to strongly disagree, disagree, neither disagree nor agree, agree or strongly agree (5-point Likert scale) to the various statements put forward in Table 3.

**TABLE 3: THE 5-POINT (Likert) RESPONSE SCALE**

Response	Scale
Strongly disagree	1
Disagree	2
Neither disagree nor agree	3
Agree	4
Strongly agree	5

A second questionnaire was used to compile a frequency table on the consumption of frozen vegetables. Consumers were asked to indicate how frequently a number of frozen vegetables were eaten. They had the choice to answer every day, more than once a week, once a week (any day), once a week (only on weekends), every second week, once a month, seldom, never and don't know.

### Analysis of data

The quantitative data produced by the survey was analysed by using the Statistica®-programme in order to generate the relevant tabulations, descriptive statistics and statistical tests. The mean values of individual attribute ratings for four race groups were compared by means of an analysis of variance (ANOVA). The ANOVA procedure only identifies the individual attributes in respect of which significant differences occurred. It does not indicate between which of the subgroups within variables the difference actually exists. For this reason a post hoc test was done to determine the significant differences between group means in an ANOVA. The Unequal N HSD test is a modification of the Tukey

HSD test and provides a reasonable test of differences in group means (Winer *et al*, 1991). Usually after obtaining a statistically significant F test from the ANOVA, one wants to know which means contributed to the effect, that is, which groups are particularly different from each other. Post-hoc comparison techniques specifically take into account the fact that more than two samples were taken.

Furthermore, Steyn and Ellis (2003) reported that statistical significance tests have a tendency to yield small p-values as the size of the data sets increase. They state that the effect size is independent of sample size and is a measure of practical significance. This is a large enough effect to be important in practice and is described for differences in means as well as for the relationship in two-way frequency tables. To summarize, the practical significance of results is not only important when the results of population data are reported, but also to comment on the practical significance of a statistically significant result in the case of random samples from populations (Steyn & Ellis, 2003).

A Tukey's multiple comparison test was, therefore, performed on the means of the variables to determine practical significance where statistically significant differences were found with the ANOVA. This was done by using the standardised difference between two means divided by the estimate for standard deviation. This yielded the d value (Steyn, 2000:1-3). Cohen (1988) gave the following guidelines for the interpretation of the effect size: Small effect:  $d = 0.2$ , medium effect:  $d = 0.5$ , large effect:  $d = 0.8$ . Data with  $d \geq 0.8$  is considered as practically significant, since it is the result of a difference having a large effect. However, in the results tabulated below, all effects of practical significance were reported for statistically significant differences found with the ANOVA, whether small, medium or large.

## RESULTS

The results are shown in Table 4 below and in the Appendix (pages 76-79).

**TABLE 4: CONSUMERS' ATTITUDES TOWARDS FROZEN VEGETABLES**

Variables	Product Characteristics/Attributes					
	F6_08 Choice	F6_09 Shelf life	F6_15 Taste	F6_17 Convenience	F6_18 Goodness	F6_19 Appearance
<b>Race</b>						
White(1)	2.44 <sup>abc</sup>	4.14 <sup>a</sup>	2.15 <sup>ab</sup>	3.28 <sup>ab</sup>	2.44 <sup>ab</sup>	2.47 <sup>abc</sup>
Black(2)	2.61 <sup>ade</sup>	4.20 <sup>b</sup>	2.30 <sup>acd</sup>	2.82 <sup>ac</sup>	2.61 <sup>ac</sup>	2.86 <sup>ade</sup>
Coloured(3)	2.27 <sup>bdf</sup>	4.38 <sup>abc</sup>	2.12 <sup>c</sup>	3.22 <sup>cd</sup>	2.50 <sup>d</sup>	2.59 <sup>bdf</sup>
Indian(4)	1.93 <sup>cef</sup>	4.22 <sup>c</sup>	1.98 <sup>bd</sup>	2.93 <sup>bd</sup>	2.17 <sup>bcd</sup>	2.10 <sup>cef</sup>
Practical significance	2-4(0.65) 1-4 (0.49)	NONE	NONE	NONE	NONE	2-4 (0.67)
<b>Age</b>						
18-30 (1)	2.53 <sup>a</sup>	4.18 <sup>a</sup>	2.31 <sup>abc</sup>	2.92 <sup>a</sup>	2.60 <sup>ab</sup>	2.73 <sup>a</sup>
31-45 (2)	2.52 <sup>b</sup>	4.26 <sup>ab</sup>	2.22 <sup>ad</sup>	3.06 <sup>ab</sup>	2.53	2.68
46-60 (3)	2.48 <sup>c</sup>	4.14 <sup>b</sup>	2.15 <sup>be</sup>	3.00	2.45 <sup>a</sup>	2.66
61+ (4)	2.34 <sup>abc</sup>	4.19	2.02 <sup>cde</sup>	2.88 <sup>b</sup>	2.46 <sup>b</sup>	2.55 <sup>a</sup>
Practical significance	NONE	NONE	NONE	NONE	NONE	NONE
<b>Education</b>						
Less than high school (1)	2.43	4.16	2.18	2.74 <sup>a</sup>	2.48	2.83 <sup>a</sup>
More than primary school (2)	2.50	4.21	2.23	3.03 <sup>a</sup>	2.54	2.66 <sup>a</sup>
Practical significance	NONE	NONE	NONE	NONE	NONE	NONE
<b>Gender</b>						
Men (1)	2.45 <sup>a</sup>	4.20	2.19 <sup>a</sup>	2.92 <sup>a</sup>	2.51	2.70
Women (2)	2.54 <sup>a</sup>	4.21	2.25 <sup>a</sup>	3.05 <sup>a</sup>	2.55	2.68
Practical significance	NONE	NONE	NONE	NONE	NONE	NONE

Means for each separate question and variable with a symbol in common, differ statistically significantly from each other (p<0.05)

Practical significance: Small effect: d = 0.2, medium effect: d = 0.5, large effect: d = 0.8 e.g. a medium effect size (d=0.65) was found between groups 2 (black) and 4 (Indian).

TABLE 4 (Continued)

Product Characteristics/Attributes						
Variables	F6_08 Choice	F6_09 Shelf life	F6_15 Taste	F6_17 Convenience	F6_18 Goodness	F6_19 Appearance
<b>LSM</b>						
LSM 2	2.36 <sup>ab</sup>	4.30 <sup>a</sup>	2.17 <sup>a</sup>	2.45 <sup>abcdefg</sup>	2.07 <sup>abcdefg</sup>	2.49 <sup>abc</sup>
LSM 3	2.50 <sup>cd</sup>	3.98 <sup>abcdef</sup>	2.28 <sup>bck</sup>	2.59 <sup>hijklmn</sup>	2.72 <sup>aijklmn</sup>	2.98 <sup>adefgh</sup>
LSM 4	2.65 <sup>aefgh</sup>	4.14 <sup>gh<sup>i</sup></sup>	2.42 <sup>adefgh</sup>	2.84 <sup>anopq</sup>	2.73 <sup>bopqrst</sup>	2.91 <sup>bijklm</sup>
LSM 5	2.69 <sup>bijklm</sup>	4.26 <sup>bg</sup>	2.30 <sup>ij</sup>	2.88 <sup>bnrst</sup>	2.64 <sup>cuvw</sup>	2.84 <sup>cnopqr</sup>
LSM 6	2.45 <sup>in</sup>	4.27 <sup>cij</sup>	2.09 <sup>bdi</sup>	2.95 <sup>ciuvw</sup>	2.46 <sup>diou</sup>	2.64 <sup>doms</sup>
LSM 7	2.25 <sup>cejno</sup>	4.22 <sup>d</sup>	2.20 <sup>e</sup>	2.92 <sup>djxyz</sup>	2.50 <sup>ejpq</sup>	2.55 <sup>ejo</sup>
LSM 8	2.29 <sup>dfk</sup>	4.24 <sup>e</sup>	2.22 <sup>f</sup>	3.23 <sup>ekprxz</sup>	2.48 <sup>kr</sup>	2.60 <sup>fkpt</sup>
LSM 9	2.46 <sup>gio</sup>	4.12 <sup>hj</sup>	2.23 <sup>gk</sup>	3.31 <sup>flpsvy</sup>	2.46 <sup>glmsv</sup>	2.61 <sup>glqu</sup>
LSM 10	2.35 <sup>hm</sup>	4.21 <sup>f</sup>	2.09 <sup>ch<sup>ik</sup></sup>	3.40 <sup>gmqlwz</sup>	2.42 <sup>hntw</sup>	2.40 <sup>hmrstu</sup>
Practical significance (d)	4 - 7 (0.38) 4 - 8 (0.33) 5 - 7 (0.41) 5 - 8 (0.37)	2 - 3 (0.36) 2 - 5 (0.31) 3 - 6 (0.33)	4 - 6 (0.33) 4 - 10 (0.33)	2 - 4 (0.33), 2 - 5 (0.36) 2 - 6 (0.42), 2 - 7 (0.39) 2 - 8 (0.65), 2 - 9 (0.72) 2 - 10 (0.80), 3 - 8 (0.53) 3 - 10 (0.67), 4 - 8 (0.33) 4 - 9 (0.40), 4 - 10 (0.47) 5 - 9 (0.36), 5 - 10 (0.43) 6 - 10 (0.38), 7 - 9 (0.33) 7 - 10 (0.40)	2 - 3 (0.61), 2 - 4 (0.62), 2 - 5 (0.54), 2 - 6 (0.37), 2 - 7 (0.41), 2 - 8 (0.38), 2 - 9 (0.38), 2 - 10 (0.33),	2 - 3 (0.43), 2 - 4 (0.37), 2 - 5 (0.31), 3 - 7 (0.38), 3 - 8 (0.33), 3 - 9 (0.32), 3 - 10 (0.51), 4 - 7 (0.32), 4 - 10 (0.45)

Means for each separate question and variable with a symbol in common, differ statistically significantly from each other (p<0.05)

Practical significance: Small effect: d = 0.2, medium effect: d = 0.5, large effect: d = 0.8.

LSM (Living standard measure)

## **Choice**

Respondents were asked to respond to the statement "I believe that frozen vegetables are the healthiest choice".

A practical significance was seen between whites (mean = 2.44) versus Indians (mean 1.93) and blacks (mean = 2.63) versus Indians (mean = 1.93), with Indians disagreeing the most. The opinion of whites and blacks were ambiguous, neither agreeing nor disagreeing.

The different age groups also exhibited negative attitudes toward this belief. There was no practical significant difference seen between the four age groups, although age group 61+ years differed statistically significantly from the other groups. The age group 61+ disagreed the most and the age group 18-30 the least.

Both levels of education disagreed with this statement. The respondents in the "less than high school" group (mean = 2.43) disagreed slightly more than the respondents in the "more than primary school group" (mean = 2.50). There was no practical or statistically significant difference observed between the two groups.

There was also no significant difference found between the attitudes of men and women towards this statement. Both groups disagreed and men (mean = 2.45) disagreed slightly more than women (mean = 2.54).

All the LSM groups disagreed with this statement. There were statistically significant differences seen between all of the groups. Small, practical significant differences were also found between LSM group 4 and 7 - 8 and between LSM 5 and 7 -8. LSM group 7 (mean = 2.25) disagreed the most and LSM group 5 (mean = 2.69) disagreed the least.

## **Shelf life**

The consumers' attitude regarding shelf life was also tested and respondents were asked to express an opinion on the following statement, "I believe that fresh vegetables are the healthiest choice, depending on how long they have been on the shelf".

All race groups exhibited positive views toward this statement (Table 4). There was no practically significant difference ( $d < 0.8$ ) found between the different race groups. A statistically significant difference was observed between coloureds (mean = 4.38) and the other races. Coloured respondents agreed the most whilst whites (mean = 4.14) agreed the least.

There was no practical significant difference between the different age groups and all groups exhibited similar views. A statistically significant difference was observed between the age group 31-45 and the age groups 18-30 and 46-60 (see Table 4 ). All groups agreed and the age group 32-45 years old agreed the most (mean = 4.26). The age group 46-60 (mean = 4.14) agreed the least.

Respondents with both levels of education agreed to this statement. Those with an education level "more than primary school" (mean = 4.21) agreed slightly more than the "less than high school" group (mean = 4.16). No practically or statistically significant difference was found between the two groups.

Men (mean = 4.20) and women (mean = 4.21) exhibited similar views and agreed to the statement. Again no practically or statistically significant difference was found between the two groups.

Overall, all LSM groups agreed with this statement. The LSM group 2 (mean = 4.30) agreed the most and the LSM group 3 (mean = 3.98) the least. Statistically significant differences were found especially between LSM group 3 and the rest of the groups. Small practical significant differences were also found between LSM group 2 and 3, 2 and 5 and LSM group 3 and 6.

## **Taste**

When respondents were asked if they thought that frozen vegetables tasted better than fresh vegetables, the majority disagreed.

All the race groups disagreed and the Indians (mean = 1.98) disagreed the most. Blacks were seen to disagree the least (mean = 2.30). There was no practical significant differences between the groups, however, statistically significant differences were found (see Table 4).

The different age groups also exhibited a negative response and the age group 61+ (mean = 2.02) disagreed the most. The age groups 18-30 (mean = 2.31) disagreed the least. Statistically significant differences, but no practical significant differences were found between the different age groups.

Respondents with an education level "Less than high school" (mean = 2.18) disagreed slightly more than the "More than primary school group" (mean = 2.23). No statistically or practical significant differences were found between the two groups.

Both men and women disagreed to this statement and the females (mean = 2.25) disagreed slightly less than the males (mean = 2.19). A statistically, but no practical significant difference was found between the two groups.

The overall majority of LSM groups disagreed with this statement. The respondents were found to be very negative towards this statement and the LSM groups 6 and 10 (mean = 2.09 for both) disagreed the most. The LSM group 4 (mean = 2.42) disagreed the least and statistically significant differences were especially seen between this group and the others. Practical significant differences were found between LSM group 4 and 6 as well as group 10, respectively.

## **Convenience**

Respondents were also questioned on the convenience aspect of frozen vegetables. They were asked to respond to the statement "Life is so busy, so I use frozen vegetables to make things easier for me and to save time".

Whites and coloureds (means 3.28 and 3.22 respectively) tended to agree whereas blacks and Indians (means 2.83 and 2.93 respectively) disagreed that frozen vegetables are used for convenience and to save time. Statistically significant differences were found between the different race groups (see Table 2). However, no practically significant differences were found between the groups.

There were no practically significant differences between the age groups ( $d < 0.08$ ). There was a statistically significant difference found between the age group 31-45 and age groups 18-30 and 61+. The age groups 31-45 and 46-60 (means 3.06 and 3.00 respectively) had an ambiguous opinion, scoring a mean of 3 on the 5-point response scale. The age groups 18-30 and 61+ (means 2.92 and 2.88 respectively) disagreed with this statement.

Although not practically significant, there was a statistically significant difference seen between the two levels of education. The "less than high school" group (mean = 2.74) disagreed and the "more than primary school" group (mean = 3.03) did not agree or disagree.

There was a statistically significant difference seen between the responses of men and women. The men disagreed (mean = 2.92) and the women had an ambiguous opinion (mean = 3.05). No practical significant difference was found.

A large number of practical significant differences were found between the LSM groups. The largest significant difference was found between LSM group 2 and 10 ( $d = 0.80$ ). Practical significant differences were found between LSM groups 2 and 4, 5, 6, 7, 8 and 9. There were also practical significant differences between LSM group 3 and 8 as well as group 10 and LSM groups 4 and 8, 9 and 10 and LSM group 5 and 9 and 10 and LSM group 6 and 10. Finally, practical significant differences were also found between LSM group 7 and 9 as well as 10 (see Table 4). There were also statistically significant differences between all LSM groups (see Table 4). The LSM group 2 (mean = 2.45) disagreed

the most and the LSM group 10 (mean = 3.40) the least. Overall the LSM groups exhibited negative attitudes towards this statement.

### **Goodness**

A question concerning the knowledge of consumers towards frozen vegetables was asked and consumers had to respond to the statement "I believe that frozen vegetables are the healthiest choice, because the goodness has been locked in".

The majority of consumers disagreed with Indians (mean = 2.17) disagreeing the most. Statistically significant differences were found between the different race groups, although not practically significant. The blacks (mean = 2.61) disagreed the least.

The overall response of the consumers within the different age groups also exhibited negative beliefs towards this statement. The age group 46 - 60 exhibited the most negative response with a mean response score of 2.45 on the 5-point response scale. The age groups 18-30 (mean = 2.6) disagreed the least. A statistically significant difference was found between the age group 18-30 and the 46-60 and 61+ age groups respectively. However, no practically significant difference was found.

The educational level "less than high school" respondents (mean = 2.48) disagreed slightly more than those from the "more than primary school" level (mean = 2.54). No practical or statistically significant difference was seen between the two groups.

Men and women disagreed and there were neither statistically nor practically significant differences found between the groups.

Overall, all LSM groups disagreed with this statement. The LSM group 2 (mean = 2.07) disagreed the most and the LSM group 4 (mean = 2.73) the least. Small to medium practical significant differences were found between LSM group 2 and 3, 4, 5, 6, 7, 8, 9 and 10 (see Table 4). Statistically significant differences were also found between all the LSM groups (see Table 4).

### **Appearance**

When respondents were asked to respond to the statement "Frozen vegetables look more appetizing than fresh vegetables when cooked", the answers were negative overall, falling between 2 and 3 on the 5-point response scale.

There was a practically significant difference seen between the blacks and Indians with means 2.86 and 2.10 respectively. The Indians disagreed the most and the blacks the least. Statistically significant differences were seen between the different race groups.

The different age groups all had negative attitudes towards this statement and the age group 65+ (mean = 2.66) disagreed the most. The age group 18-30 (mean 2.73) disagreed the least. There was also a statistically significant difference found between these two groups. No practical significance difference was found between any of the groups.

There was a statistically significant difference seen between the two educational levels with the "less than high school" (mean = 2.83) disagreeing less than the "more than primary school" group (mean = 2.66).

Men and women appeared to have similar attitudes towards this statement and both groups disagreed. No statistically or practically significant difference was found between the groups.

All LSM groups also exhibited negative attitudes towards this statement. Practical and statistically significant differences were found between LSM groups. Practical significant differences were found between LSM group 2 and 3, 4 and 5 as well as LSM group 3 and 7, 8, 9 and 10. Practical significant differences were also found between LSM group 4 and 7 and 4 and 10 (see Table 4). These differences were found to be of small to medium effect size. The LSM group 10 (mean = 2.40) disagreed the most and the LSM group 3 (mean = 2.98) the least.

## Frequency of frozen vegetable consumption

Results on the frequency of frozen vegetable consumption are shown in Table 5 below.

**TABLE 5: FREQUENCY OF FROZEN VEGETABLE CONSUMPTION**

	Every day	More than once a week	Once a week - any day	Once a week - only on weekends	Every second week	Once a month	Seldom	Never	Don't know
Broccoli	0.26%	0.23%	2.97%	1.00%	1.49%	2.42%	6.70%	84.56%	0.36%
Brussels sprouts	0.08%	0.07%	1.16%	0.77%	0.84%	1.79%	4.83%	90.22%	0.23%
Cabbage	0.67%	0.05%	3.20%	1.09%	1.32%	1.28%	5.15%	84.67%	2.57%
Carrots	1.92%	0.56%	8.45%	3.90%	3.48%	5.36%	11.73%	63.47%	1.13%
Cauliflower	0.87%	0.20%	4.31%	1.90%	1.87%	3.37%	7.19%	79.83%	0.47%
Chips	1.17%	0.48%	5.27%	2.73%	2.59%	4.08%	10.21%	72.32%	1.15%
Green beans	1.39%	0.52%	6.68%	4.26%	3.38%	5.34%	11.55%	65.88%	0.99%
Mixed vegetables	4.39%	2.11%	17.45%	10.41%	7.41%	9.08%	12.69%	35.99%	0.47%
Peas	1.88%	1.11%	14.29%	7.20%	5.68%	6.11%	12.94%	50.00%	0.79%
Potatoes	1.69%	0.29%	2.93%	1.64%	1.22%	1.32%	4.68%	84.62%	1.62%
Pumpkin/butternut	0.52%	0.13%	2.81%	2.60%	0.88%	1.99%	5.35%	84.33%	1.38%
Spinach	0.42%	0.07%	2.66%	0.94%	0.86%	2.19%	5.28%	86.22%	1.36%
Sweetcorn	0.46%	0.36%	4.39%	2.15%	1.63%	3.47%	7.01%	79.56%	0.96%
Sweet potatoes	0.21%	0.04%	1.82%	1.47%	0.60%	1.30%	5.64%	87.19%	1.74%
Average consumption:	1.14%	0.45%	5.60%	3.00%	2.37%	3.51%	7.93%	74.92%	1.09%

Respondents were asked how often they personally ate various frozen vegetables as indicated in Table 5. Results indicated that the average consumption of frozen vegetables is poor and 74.92% consumers indicated that they never ate frozen vegetables. Only 5.60% consumers ate frozen vegetables once a week (any day) and a mere 1.14% every day.

Results of individual frozen vegetables were a bit more promising. For mixed vegetables 17.45% respondents indicated that they eat it once a week (any day) and 10.41% once a week (only on weekends). Only 35.99% consumers indicated that they never eat frozen mixed vegetables. Frozen peas were eaten by 14.29% respondents once a week (any day) and by 7.20% once a week (only on weekends). Frozen green beans and frozen carrots were eaten by 6.68% and 8.45% respondents respectively once a week (any day).

## DISCUSSION

Sargeant and West (2001:97) state that the formation of attitudes is linked to a basic survival and coping requirement. Attitudes help to make sense of the world and to maintain self-image. There is a social component in holding many attitudes. Attitudes are formed individually, but there are interactions with

other people in their formation, particularly family and friends. Attitudes enable people to rebel or integrate (identify) with their groups and society at large and attitudes towards products are part of this process (Sargeant & West, 2001:97).

An attitude, in buyer behaviour terms, is a lasting, general, evaluation of products and ideas. Attitudes are formed by personal usage or trust in the attitudes of other influential users (beliefs may be formed without product experience) (Seargent & West, 2001:71).

## **Choice**

According to Pollard *et al* (2002:374), the choices individuals make around foods determine which nutrients are consumed. However, consumers do not choose their foods exclusively for the nutrients they provide. Eating behaviour is complex and understanding the factors that affect food choice are important given the priority for population dietary change.

Results from this study show that overall, respondents in South Africa disagree that frozen vegetables are the healthiest choice. According to Klein (1997:1-15), consumers in the USA also seem to believe that fresh fruits and vegetables provide more vitamins and fibre than their processed counterparts. Klein (1997:1-15) states that consumers believe that processing destroys nutrients and adds preservatives. This indicates a lack of understanding about how foods are handled for freezing (Klein, 1997:1-15).

According to Brunnhofer (2003) of the Austrian Consumers' Association, frozen vegetables are grown in their normal season and are processed quickly so all their goodness is preserved. Thane & Reddy (1997:58-65) found that freezing, particularly rapid freezing, does not alter the nutritional value of the product. Klein (1997:1-15) states that the science behind freezing "in" the nutrients of vegetables is that by blanching first, the enzymes that cause oxidation of vitamins are inactivated. Consumer education is clearly much needed to dispel the myth that freezing destroys nutrients.

In South Africa, Indians disagreed most and a practical significant difference was seen between their mean response score and those of blacks and whites. This revealed that Indians were far more negative towards this question compared to the other race groups. As reported by Pollard *et al* (2002:377), some of the largest variations in food choice are due to the boundaries laid down by cultures and traditions because they give the consumer values and beliefs in different food and eating patterns.

The age group 61+ was the most negative towards this statement. It is tempting to speculate that the consumers in this age group are not familiar with convenience food and still believe that fresh vegetables are healthier. The perceived higher cost of frozen vegetables may also be a barrier for this

group of senior citizens, mostly pensioners. Indians, age group 61+, the "less than high school education" group and men disagreed most to this question.

All LSM groups disagreed that frozen vegetables are the healthiest choice, indicating that fresh is still healthier. The availability of freezing storage facilities might have influenced their response (see Table 6).

### **Shelf life**

Consumers revealed good knowledge with regard to the quality of fresh vegetables and their shelf life. Klein (1997:1-15) stated that fresh produce may be picked at its peak of nutrition, but during transit time, it is gradually dying, so it has used up the nutrients through its own metabolism. In contrast, frozen fruits and vegetables don't have that problem (Klein, 1997:1-15). In this study, all the groups agreed that shelf life might influence the quality of vegetables depending on how long they've been on the shelf. Coloureds, the age group 31-45 years, the "more than primary school" education group and women mostly agreed to this statement.

All LSM groups also agreed that shelf life does have an influence on vegetable quality.

Only LSM group 4 had an ambiguous opinion. No large practical significant difference was seen between groups.

### **Taste**

Pollard *et al* (2002:375) reported that a number of studies have found that sensory factors influence eating behaviour tremendously. Results from this study revealed that the majority of consumers were not familiar or were not comfortable with the taste of frozen vegetables. Pollard *et al* (2002:377) also state that cultural and traditional practices are the foundations on which all food choice decisions are built. This was seen with Indians and the age group 61+ who were very negative about the taste of frozen vegetables. Yet again, the age group 61+ might not be familiar with frozen vegetables and still prefer fresh vegetables as set forth from traditional beliefs.

Other researchers also stated the importance of good taste. In a pan-European survey, quality, followed by taste, was the most mentioned influence reported, looking at consumer attitudes to food, nutrition and health. This was the case for both the European Union sample and the UK sub-sample (Institute of European Food Studies, 1996). A Dutch survey used focus group interviews to study determinants of fruit and vegetable intake (Brug *et al*, 1995:287). The authors found that, when looking at satisfaction

beliefs, good taste was an essential prerequisite for the consumption of fruit and vegetables (Brug *et al*, 1995:292).

In a US study, focus group participants indicated that good taste was perceived as a benefit of increasing intakes of fruit, although taste was also regarded as a barrier for increasing intakes of cruciferous vegetables (Heimendinger & van Duyn, 1995). Recent work in the area of taste genetics showed that individual differences in the ability to taste certain compounds may be a determinant of food rejections (Fisher *et al*, 1961; Glanville & Kaplan, 1965). The ability to taste the bitter compounds 6-n-propylthiouracil and phenylthiocarbamide is a genetically inherited trait and these substances are bitter to some people and tasteless to others (Fisher *et al*, 1961; Glanville & Kaplan, 1965). More recently, research has found that sensitivity to 6-n-propylthiouracil solutions has been associated with more reported food dislikes. Taste preferences have been shown to influence food choice behaviour, but few studies have examined taste responses, food preference and intake patterns in the same free-living populations (Pollard *et al*, 2002:375 - 377).

A study amongst low income, multi-ethnic worksite groups in the USA highlighted perishability, inconvenience, cost, storage difficulties, preparation time, taste dislikes, poor availability and difficulty changing old habits as possible barriers for vegetable consumption (Cohen *et al*, 1998:381-386; Cox *et al*, 1996:44-47). In South Africa, Love *et al* (2001:9-19) found that all groups (black, coloured, Indian and white) stated that with regard to taste, most resistance to vegetable and fruit consumption came from children and, in some cases, the men in the household (Love *et al*, 2001:9-19).

In this study, all LSM groups were of opinion that fresh vegetables still taste better than frozen. It can be concluded that taste dislikes still play an important role in the attitude formation of consumers.

## **Convenience**

Heimendinger and van Duyn (1995) reported that vegetable preparation time was found to be a barrier for increasing vegetable consumption. The results from this study, however, still indicated overall negative attitudes of South African consumers towards the use of frozen vegetables as a possible solution. Pollard *et al* (2002:381) reported that time constraints are a big issue in food choice and that individuals make constant conscious choices around issues of convenience. Whites and coloureds, the age groups 31-45 and 46-60, the group with "more than primary school education" and females had an ambiguous opinion to this statement and one can speculate that the use of frozen vegetables might be considered as a possible solution. Blacks, Indians and the age groups 18-30 and 61+ disagreed. The "less than high school education" group and males also disagreed with this statement.

Pollard *et al* (2002:380) are of the opinion that in relation to fruit and vegetables consumption, availability could account for a large proportion of the food choice process. If individuals are dependent of public transport, or have to walk, fruit and vegetables are heavy and bulky to carry and might not be bought. On the other hand, if they do take the effort to buy vegetables, much can't be bought at one time, because it can't be stored for too long before it starts to deteriorate. Frozen vegetables can be stored longer if they have the facilities to store them and will be able to keep them frozen until they get home. It was decided to analyse the results of this study further to determine which groups do have fridge/freezers or deep freezers to be able to store frozen vegetables. A frequency table was developed (see Table 6) with the different availability percentages for each LSM group.

**TABLE 6: AVAILABILITY OF FRIDGE/FREEZERS AND DEEP FREEZERS BETWEEN LSM GROUPS**

Frequency table: LSM's with freezer/fridge or deep freeze	
LSM2	1%
LSM3	9%
LSM4	59%
LSM5	95%
LSM6	98%
LSM7	100%
LSM8	100%
LSM9	100%
LSM10	100%

LSM= Living Standards Measure

Of all the consumers in LSM group 2, 99% indicated that they don't have fridge/freezers or deep freezers. From these results it can, therefore, be speculated that the LSM group 2 (mean = 2.45) who disagreed the most did not find it convenient to buy frozen vegetables because they did not have the facilities to store frozen products. Of all the consumers in LSM group 10, 100% indicated that they either have a fridge/freezer or a deep freezer or both. Therefore, the LSM group 10 (mean = 3.40) who were more positive to this statement, might actually consider the use of frozen vegetables for convenience.

### Goodness

Dittus *et al* (1995) reported that a belief in the health benefits of fruit and vegetables may well increase consumption and also found that an individual's concern about nutrition is positively related to their dietary behaviour. Although all consumers disagreed to the statement "I believe that frozen vegetables are the healthiest choice, because the goodness has been locked in", no clear conclusion can be made because of the ambiguous nature of this question. Two possible conclusions can be made and consumers can either believe that fresh vegetables are still the healthiest choice or they do not believe

that goodness can be locked in vegetables with the freezing technique. This is a limitation of the study, namely, construction of a statement in such a way that it could have been misinterpreted.

Indians were again found to be the most negative about this statement. There were no practical significant differences between any of the other variables (see Table 4) and it can be concluded that most consumers still believe that fresh vegetables are the healthiest choice or are not familiar of the benefits of frozen vegetables.

Overall, the LSM groups disagreed that frozen vegetables are the healthiest choice but again the question might have been misinterpreted.

Because of the ambiguous nature of this statement, further analyses were made with data from another sub-section in the questionnaire. Respondents were asked to strongly agree, agree, neither agree nor disagree, disagree and strongly disagree to the statement "I am not convinced that vegetables are healthy". It was found that 26% of all the respondents agreed to this question indicating that education on the health benefits of vegetables in South Africa is urgently needed.

## **Appearance**

Pollard *et al* (2002:375) reported that the properties of individual foodstuffs, such as taste, texture, quality, smell and appearance play an important role in whether a person will choose to consume an item. In this study, the attitudes of consumers toward the appearance of frozen vegetables were found to be very negative. An interesting differentiation emerged between Indians and blacks. Although both race groups were exhibiting negative attitudes towards this statement, there was a practical significant difference seen between their mean response rate. Indians disagreed more strongly with the statement "frozen vegetables look more appetizing than fresh when cooked" than blacks who had a more ambiguous opinion. The age group 61+ also felt that frozen vegetables did not look more appetizing than fresh when cooked. The younger generation (age 18–30 years of age) disagreed less than the 61+ age group and it can be speculated that they are more familiar with frozen vegetables than older people.

All the different living standard groups felt that fresh vegetables look more appetizing than frozen vegetables when cooked. McWilliams (2001:472) reported that when vegetables are blanched before they are frozen, chlorophyll is set which gives the bright green colour seen in frozen vegetables. It can, therefore, be concluded that consumers are either not familiar with frozen vegetables or incorrect cooking techniques may be used.

## **Frequency of frozen vegetable consumption**

The average consumption of frozen vegetables in general indicated that 74.92% respondents never eat frozen vegetables. Du Plessis *et al* (1994:7-8) conducted a comparative study to determine the producers' and consumers' attitudes towards frozen vegetables in the South African retail market. They found that producers were more positive towards frozen vegetables than consumers. Consumers were the most negative about the expensiveness of frozen vegetables compared to fresh vegetables. Consumers, however, frequently do not fully understand in advance all the ways in which a product might provide value. Sellers have the opportunity to take this inadequate knowledge regarding value and educate buyers about differentiating features. By this they can endeavour to change their attitudes towards products (Du Plessis *et al*, 1994:7-8).

## **SUMMARY AND RECOMMENDATIONS**

The most disappointing finding of this study was that more than 25% of the respondents were not convinced that vegetables are healthy. Overall the attitudes of consumers towards frozen vegetables were found to be negative. Results from this study revealed practical and statistical differences between the various LSM groups, especially with regard to the convenience of frozen vegetables. The lack of freezing storage facilities in some of the lower LSM groups might have contributed to this. Health professionals have to take notice of the results when urging individuals to increase vegetable consumption.

The various age groups didn't reveal different attitudes towards frozen vegetables and were found to be negative overall. It was, however, found that the age group 61+ exhibited the most negative attitude towards frozen vegetables and there is reason to speculate that they are not familiar with frozen vegetables or that it might be too expensive. Health professionals and producers of frozen vegetables should think in terms of practical demonstrations and guidance to encourage further experimentation with frozen vegetables to increase the consumption of vegetables overall. Some supermarkets in South Africa employ dietitians to this end. They should also educate consumers on the benefits of frozen vegetables.

No practical significant differences were found between the attitudes of respondents with different levels of education and it can be concluded that education did not play an important role in consumers' attitudes towards frozen vegetables in this study. However, the "more than primary school education" group overall had a less negative attitude towards frozen vegetables than the "less than high school education" group. Walker *et al* (1999) collected information from African and white pupils aged 15-16

years on their knowledge of and attitudes towards cancer and their understanding of health-related behaviours in relation to their future experience. They found that half of both groups (African and white pupils) perceived a high intake of vegetables and fruit as protective. The most important sources of information were the television and printed media. Children in both groups were, however, more anxious about unemployment and violence, and also, among African children, about AIDS, than about future ill-health (Walker *et al*, 1999:80-84).

Kilcast *et al* (1996:48-51) stated that the major barrier to increasing the consumption of vegetables is the lack of enthusiasm shown by children. They concluded that without acceptance of vegetable-based meals by children, it is unlikely that households will continue to persist with higher vegetable diets in the long term (Kilcast *et al*, 1996:48-51)

Low vegetable consumption will equal low micronutrient levels that will lead to other health complications. Therefore, education on the Food Based Dietary Guidelines as well as the "5 a day" fruit and vegetable guideline, especially for children, is very important. This will lead to good eating habits in early childhood as well as ensuring that adequate amounts are consumed in the next generation.

Although all four race groups had negative attitudes towards frozen vegetables, Indians consistently reported to be the most negative of the four. Health professionals may use this information to identify ways to address these negative attitudes towards frozen vegetables within the Indian community. Pollard *et al* (2002:377) reported that many dietary restrictions play a part in religious and cultural beliefs, although none of these include restrictions on fruit and vegetable intakes. He states that some religious groups, however, do follow strict diets that are believed to be beneficial. More research should be done to determine how Indian's religion, traditions and habits may influence their attitudes towards frozen vegetables.

Men and women were found to be negative towards frozen vegetables overall. It was noted that females were occasionally less negative than males, especially towards the convenience attribute of frozen vegetables. They may be more willing to consider frozen vegetables in future. These speculations are supported by Beardsworth *et al* (2002:470-491) who reported that females are more sympathetic to novel foods and dietary change. They also bear the main responsibility for deciding what foods are purchased and also do most of the preparation thereof.

Nutritional professionals can use the findings of the study to target messages in health-promotion programmes to increase frozen vegetable intake. Consumers also need practical advice on how to overcome the barriers to increased vegetable consumption. Nutrition counseling efforts should specifically be aimed at increasing frozen vegetable consumption among targeted subgroups, particularly Indians, males and the age group 61+.

Multiple aggressive marketing strategies (individual, regional, provincial and national) should also be launched to enhance the effectiveness with which consumers are informed about the benefits of frozen vegetables.

In the light of results from this study, further research is needed to determine factors influencing consumers' attitudes towards vegetables in general and frozen vegetables in particular and ways to change these to better the health status of South Africans. It is strongly recommended that suitable instruments be developed and implemented to assess the knowledge and attitudes of South Africans towards vegetable and fruit consumption and the ability of individuals to affect their own health. Spreading information through the media regarding the avoidance of diet-related diseases should be intensified due to the universality of the burden of these diseases.

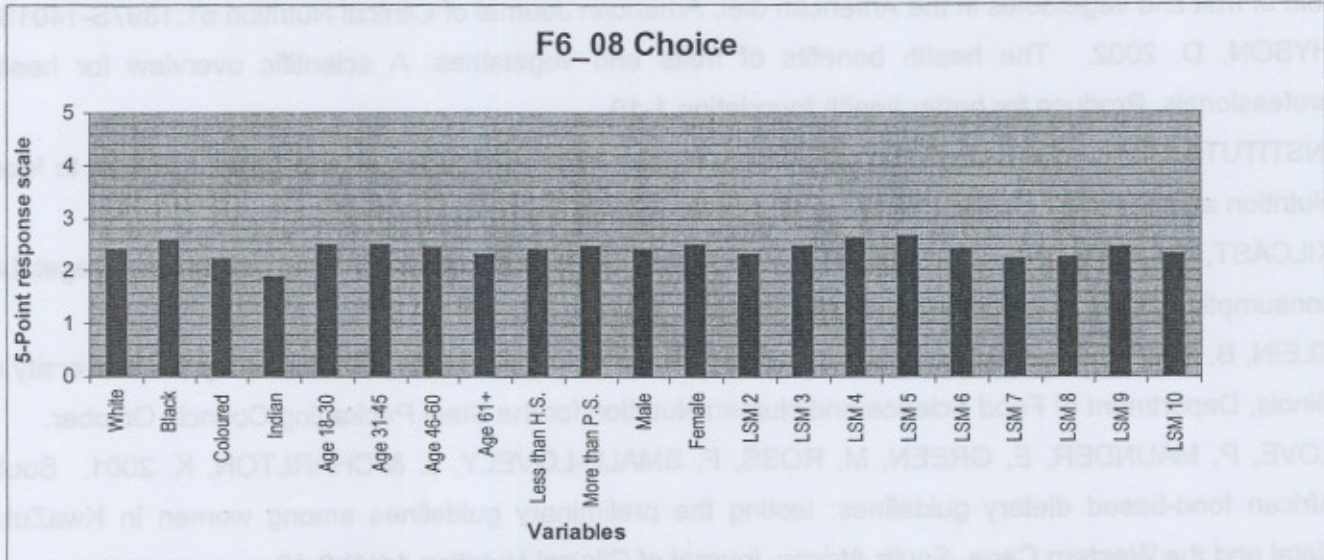
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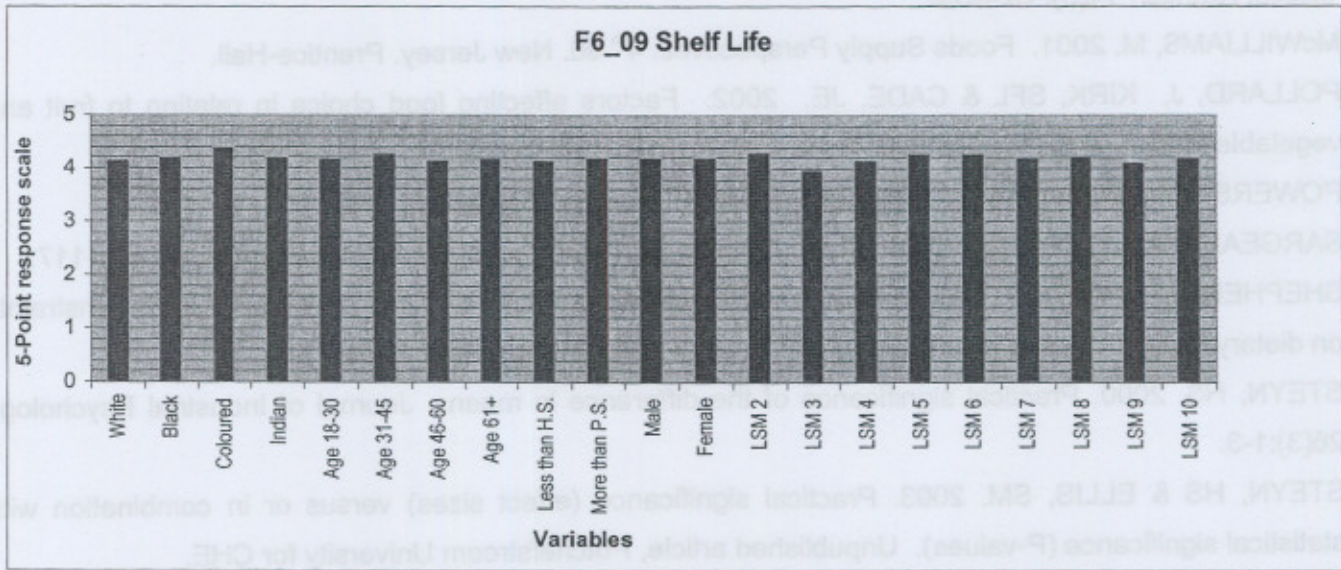
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# Appendix

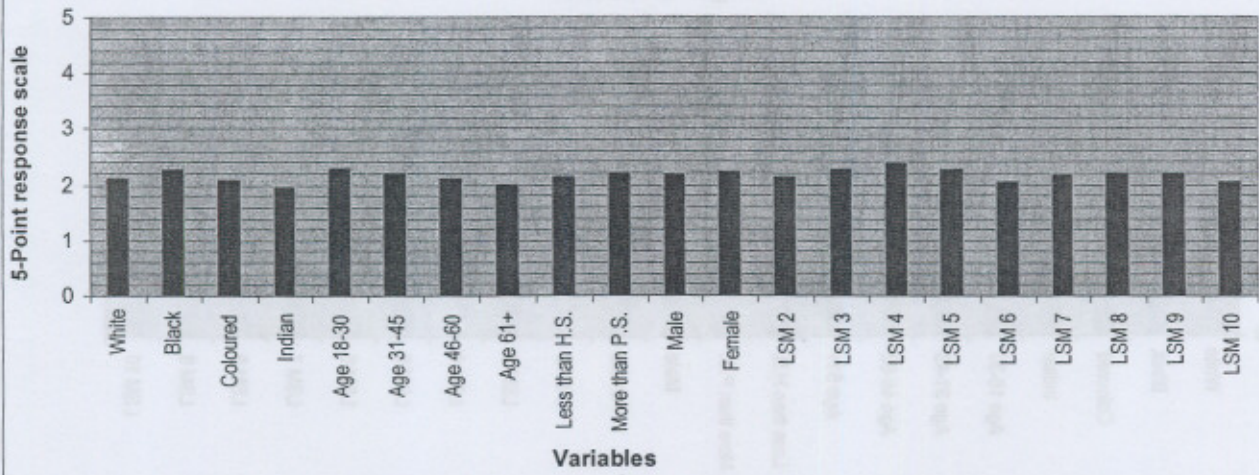
## Graphs



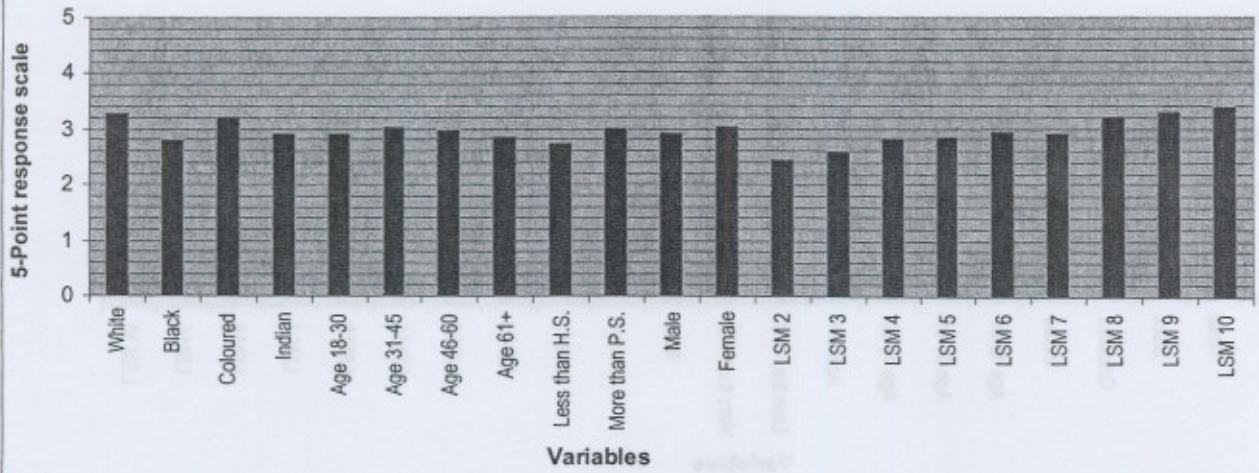
H.S. = High School P.S. = Primary School



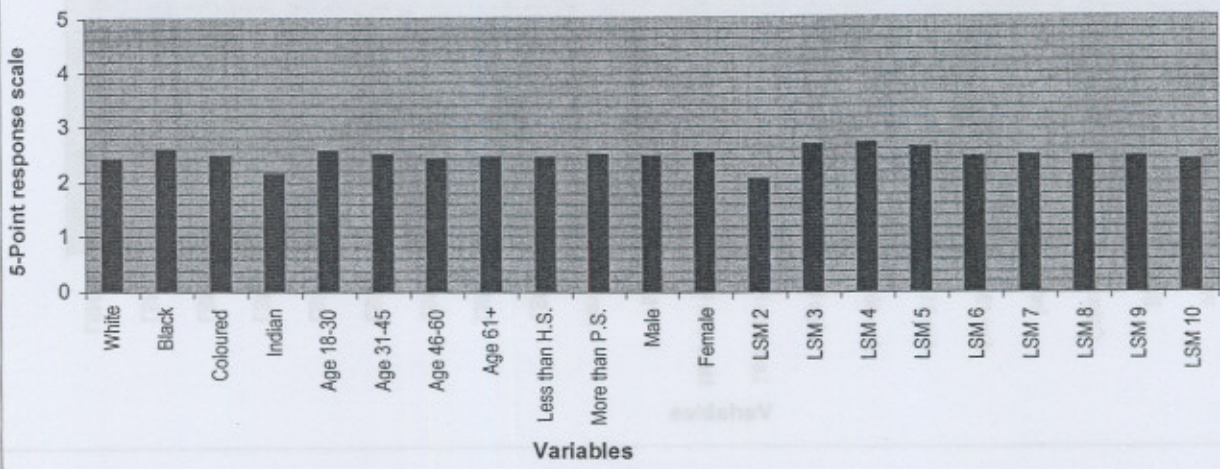
F6\_15 Taste



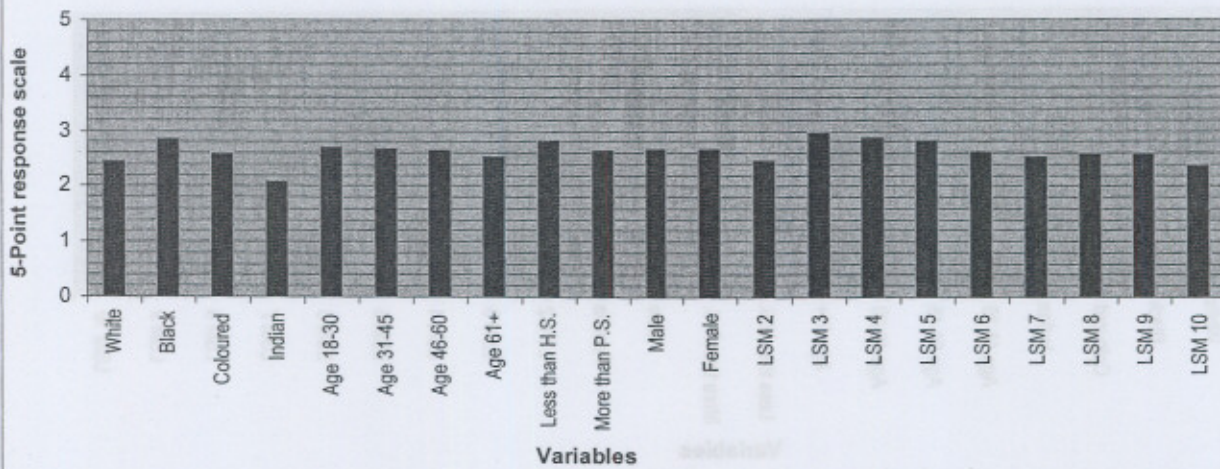
F6\_17 Convenience



F6\_18 Goodness



F6\_19 Appearance



## Frequency of frozen vegetable consumption

