

CHAPTER 2 LITERATURE SYNTHESIS ON PRODUCT DEVELOPMENT

2.1 INTRODUCTION

This chapter will focus on product development; all the processes that form part of product development will be described separately, starting with recipe development. Recipe or product development is the entire process of creating an idea or concept, for a unique recipe according to project objectives. Background information is essential to maximise the recipe's potential.

The purpose of this study was to develop an energy snack for children affected by HIV/AIDS and compromised immunity, to help their bodies to build a better immune system. The main objective was the development of an energy snack bar that would add nutrient values to their diet. According to Hullah (1984:2), recipe development is an intriguing and creative process which incorporates sound scientific techniques. Before the presentation and writing of the final recipe, the concept first needs to be systematically developed, tested and evaluated

2.2 PRODUCT DEVELOPMENT

There are certain factors to be considered in product development for people affected by HIV/AIDS and compromised immunity. As discussed in Chapter 1, HIV/AIDS has certain specific effects on a person's health and these must be taken into account when a product is developed. The combination of infections and illness leads to a poor appetite which is aggravated by a side effect of the medication: altering the taste of food. Therefore a product should be developed that is appetizing and tasty. Infections of the mouth and throat increase the difficulties of eating. Thus the developed product should be easy to eat and soft in texture, with no strong flavours.

The following facts should be taken into consideration:

- The treatment as well as the medication is expensive and the fact that the infected people cannot work results in lack of income which reduces the ability to buy food, thus increasing stress;
- The increase of stress leads to depression, which leads to fear and anxiety and contributes to the loss of appetite;
- HIV/AIDS-affected people isolate themselves from others and the community, and people in the community do not want to be in contact with those with HIV/AIDS;
- People become lonely because others are wary of socialising and eating with people with HIV/AIDS; and
- People cannot take care of themselves in the last stage of HIV/AIDS (UNICEF 2001; CFNI 2002:63-71).

The following changes are needed to adapt to the requirements of people living with HIV/AIDS. Food and recipe changes have to be made according to the availability of food as well as the preferences and tastes of the people in a specific region or setting. Recipes have to be adapted to include locally available foods to ensure that the recipes are acceptable to the people in a specific community and compatible with their way of life. Foods can be combined with local dishes to ensure a balanced meal.

The recipes must be adaptable and open to modification to suit local realities, such as local cooking procedures in respect of measures of weight and volume, availability of refrigerators and electricity and water. The nutritional problems also have to be taken into account, especially of people who are affected with HIV/AIDS, as well as the pattern of the symptoms and the availability of treatment for HIV/AIDS. The background and educational level of the users is an important factor to consider when conducting product development for people living with HIV/AIDS (FAO 2002:3-5).

As shown in Figure 2.1, a recipe/product is more than the sum total of its parts – it is a mixture of important positive recipe characteristics.

A well-developed recipe is:

- | | |
|------------------------|---|
| REPRODUCIBLE | - is written in such a way that it can be prepared repeatedly with consistent results. The written copy readily relays an accurate perception of the final product. |
| EASILY PREPARED | - a minimum of steps is involved to produce appropriate end results that are reproducible. Ingredients are used in the easiest possible unit of measure. |
| CONCISE | - is brief without sacrificing clarity, and must be clear enough for anybody to understand. |
| INTERESTING | - has overall general appeal, offers certain uniqueness and ideally has beneficial nutrient content. It adds variety to the meal, menu or as a snack. |
| PLEASING TO THE SENSES | – has a satisfying aroma and flavour with a pleasant aftertaste and appropriate mouth feel and texture, a stimulating and satisfying flavour and aroma and an appetising appearance. |
| ECONOMICAL | - not just from a budget perspective, but also affordable for the people for whom it is developed. The product/recipe can be reproduced with the material resources available to them. There is effective use of human energy and expenditure available in the specific area and community (Hullah 1984:4). |

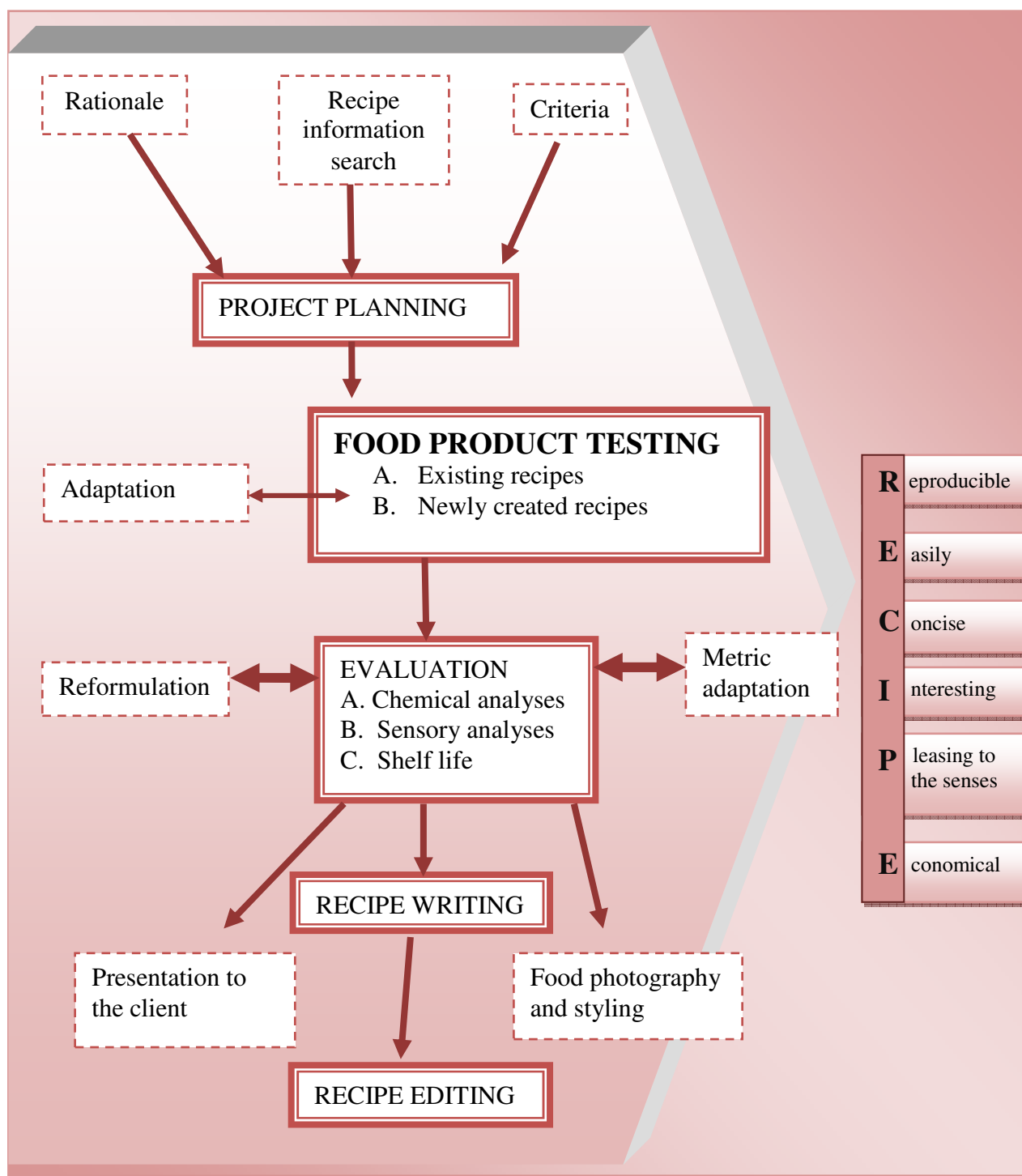


Figure 2.1 Development of Optimum Food Products (Adapted from Hullah 1984:3)

2.3 INGREDIENTS

As discussed in Chapter 1, the following symptoms (Table 2.1) affect people living with HIV/AIDS. Therefore, specific ingredients should be added to or form part of products specifically developed for such people. Food ingredients including macronutrients and micronutrients as discussed in 1.8, will be elements in the criteria for product development. The ingredients and reasons for use are summarised in Table 2.1.

Table 2.1 symptoms and recommendations for HIV/AIDS

Problems symptoms	Recommended ingredients/food items	Reasons for using these ingredients	Reference
Poor appetite, due to compromised immune system.	Eat more staple foods such as maize, rice, millet, sorghum, wheat, sweet potatoes. Increase the intake of soy products, beans, lentils, peanuts, groundnuts and seeds such as sunflower seeds and sesame seeds. Eat good snacks regularly between meals. Such snacks are chips, seeds, nuts, and snack bars or energy bars.	Appetizing. Quality control. Enhances flavour.	FAO 2002; UNICEF 2001; CFNI 2002: 63-71; NICUS 2006
Nausea and vomiting	Drink plenty of fluids after meals Try not to prepare food yourself. Eat dry and salty foods such as toast, crackers and cereal. Do not prepare the meals yourself (a snack bar will help because it is ready to eat).	Ready prepared snack bars or foods are convenient.	FAO 2002; UNICEF 2001; CFNI 2002: 63-71; NICUS 2006
Changes in the taste of foods	Experiment with different foods, and add mint, garlic, ginger and other herbs and spices. Add sugar, vinegar and lemon essence to food to increase the flavour.	Increases flavour.	FAO 2002; UNICEF 2001; CFNI 2002: 63-71; NICUS 2006

Table 2.1 continued (symptoms and recommendations for HIV/AIDS)

Diarrhoea	<p>Use mashed foods, moist foods such as soft fruit and vegetables, soft cereals and porridge and rice.</p> <p>Lost minerals can be replaced: eat soft vegetables and fruit, particularly papaya, banana, mangoes, watermelon, pumpkins, squash, potatoes and carrots.</p> <p>Eat refined foods, such as maize meals, white rice, noodles, white bread, soy and potatoes.</p> <p>Eat smaller meals more often and drink a lot of fluids after each meals.</p>	<p>Replace milk with soy milk to prevent diarrhoea.</p>	<p>FAO 2002; UNICEF 2001; CFNI 2002: 63-71; NICUS 2006</p>
Sore mouth	<p>Eat soft, mashed, smooth or moist foods such as avocados, pumpkins, squash, bananas, papaya, yogurt, soups, creamed vegetables, pasta dishes and minced food.</p> <p>Soften dry food by dipping it in liquids and add lots of liquids to foods.</p> <p>Drink lots of cold drinks, fruit juices, soups and vegetable juice.</p>	<p>Softens ingredients. gives smooth texture and flavour.</p>	<p>FAO 2002; UNICEF 2001; CFNI 2002: 63-71; NICUS 2006</p>
Lack of appetite	<p>Try to drink a lot of water, milk, (replace with soy milk) yoghurt, soups, herbal teas or juices throughout the day.</p> <p>Drink water and liquids mainly after and between meals – do not drink too much liquid before or during meals.</p> <p>Add spices such as cardamom, cinnamon, coriander and fennel especially to some lemon juice,</p>	<p>Adds flavour to food and makes it look and taste interesting.</p>	<p>FAO 2002; UNICEF 2001; CFNI 2002: 63-71; NICUS 2006</p>

2.4 QUALITY CONTROL

Quality control refers to the controllable factors that influence the quality of the finished product in either a positive way or a negative way, e.g., the selection of all the raw materials, the way the raw materials are processed, the way the products are packed, the storage methods used and the distribution of the end product. Quality can be defined as the features that characterise a product or the degree of excellence or superiority in a product. In food, the word quality can be used in various ways. For the salesman, quality in a product means that it is of a high standard and is usually also connected to the expensive nature of the product. Quality control is a procedure or set of procedures intended to ensure that a manufactured products adherence to a defined set of quality criteria or meets the requirements of the client or customer. In order to implement an affective quality control program, one must first decide which specific standards the product must meet. The more expensive a product is, the better it is thought to be: for example caviar is considered as quality when compared to fish and chips. In the case of fresh products, the word “quality” implies that the food is fresh and all aspects of a fresh product must be associated with it: for example, the colour, texture, flavour and nutritive value must be suitable to the product. The quality attributes associated with fresh products also include negative characteristics such as freedom from harmful microorganisms and substances that are undesirable for human consumption (Adu-Amankwa 1999).

The following rules of quality control must be borne in mind, especially with raw materials:

- The quality of the raw materials selected is tested to guarantee a good quality end product;
- To ensure quality products, the raw materials should be released from the stores only after the test results are properly recorded and checked;

- In process control, the processing results must be related to the raw materials tests;
- The critical points in the process should be defined and scrutinised;
- With control of the raw materials and process control in place, inspection of the final product should be reduced to the minimum; and
- The more carefully quality control measures are integrated into the overall organisation of the factory, the more effective the quality control will be (Adu-Amankwa 1999).

There are different sections under which principles of quality control have to be considered, such as raw material control, the control over the whole process of the product and the inspection of the final product. After a food product has gone through the whole manufacturing process nothing can be done about the quality of the product. The inspection of a final product permits approval of materials reaching the desired standard and rejection of material which does not meet the required standards (Adu-Amankwa 1999).

2.4.1 Hazard analysis critical control points

Hazard Analysis Critical Control Points (HACCP) are a standard internationally recommended system of food safety management. The focal points are to identify the critical points in a food service unit where food safety problems could occur and to take action by putting steps in place to prevent things going wrong. This is referred to as controlling hazards. An important component of the HACCP system is to keep a record of all important incidents and possible critical points (Hunter, Tinton, Carey & Walpole 2007:38-41; Adu-Amankwa 1999).

Seven steps are involved in the HACCP system:

- Problems that can go wrong must be identified (potential hazards).

- Identify the problem points where things can go wrong (Critical Control Points – CCPs).
- Set critical limits at each CCP (e.g. cooking temperature/time).
- Set up checks at CCPs to prevent problems occurring (monitoring).
- Decide what to do if something goes wrong (corrective action).
- Check that your HACCP plan is working (verification).
- Keep records of all of the above (documentation) (Adu-Amankwa 1999).

A HACCP plan has to be revised very often and kept up to date, especially where there have been changes in the food operational area: the plan has to be reviewed from time to time to comply with the standards of the operational area (Hunter *et al* 2007:39).

2.4.2 Food safety concerns for people living with HIV/AIDS

People living with HIV/AIDS are more vulnerable and more susceptible to infections. In any illnesses, contaminated food can easily cause an infection and could bring about further deterioration of the immune system. To prevent any illness carried in food because of contamination, it is important that food is stored, handled and prepared in a safe manner (Kennedy *et al.* 2003:11).

2.4.3 Facts to keep in mind in quality control specifically for people living with HIV/AIDS

Because hygiene and food safety for people with compromised immunity is so important the following must be kept in consideration:

- Hands must be washed thoroughly with soap and water, preferably with warm water, before handling food. This has to be done every time raw and cooked foods are touched. It is very important to wash hands after handling pets and other animals, after visits to the toilet, and after sneezing or blowing the nose.

- All wounds must be covered to prevent contamination of food during preparation and handling. The use of rubber gloves is recommended to keep wounds clean and protect the food.
- Tap water is generally safe to drink, but water obtained from a borehole, river or well must be boiled before use. Store clean boiled water in a container with a lid or cover it with a clean cloth or plastic wrap. Ice cubes should also be made with clean and safe water.
- Keep the kitchen clean and safe. Wash dishes in hot soapy, water. Wash all work surfaces with soap and water and wash kitchen floors regularly. Use separate cutting boards for raw foods, cooked foods and cheeses and a different one for vegetables and bread. Plastic or marble cutting boards are safer than wood.
- A raw egg is not safe to eat and work with: clean it before breaking it for use. Do not buy or use any damaged eggs. Cook eggs till the yolks are hard so that they are cooked right through.
- Raw meat, poultry, pork or fish should not be eaten. Cook meat poultry, pork and fish thoroughly before eating.
- Buy foods in small quantities that can be eaten before they spoil; it is safer than buying cheaper foods in large quantities. Make sure that cans are not damaged before buying. Make sure the foods bought have not reached their expiration or “sell by” date, and consume the food before or by the “best before” date. If there is any doubt about the safety of food, it should not be eaten. Always keep the food well covered and at the correct temperature.
- Make sure all fresh fruits and vegetables are washed. If they cannot be washed properly, rinse and then peel them. Discard any that are mouldy or rotten.
- It is preferable to use pasteurised milk. Boil any unpasteurised fresh milk produced that is not pasteurised before it is consumed (Kennedy & Macintyre 2003:12).

2.4.4 Food safety in South Africa

Table 2.2 Food standards available in South Africa (Oldewage-Theron & Fuller 2008: 648)

SABS Number	Year	Title	Summary
SABS 0156	1979	The handling of chilled and frozen foods	Recommends factory conditions and hygiene for food handlers. Covers the storage, transportation, handling and processing of raw and finished products. Gives optimal storage temperatures and times for a variety of uncooked and cooked products.
SABS 049	2001	Food hygiene management	Covers provisions for the hygienic handling of food and beverages for human consumption, in order to ensure a safe, sound and wholesome product.
SABS 241	2005	Drinking water	Specifies the quality that is acceptable for drinking water in terms of microbiological, physical, organoleptic and chemical parameters, at the point of delivery.
SABS 22000	2005	Food safety management systems – requirements for any organisation in the food chain	For any organisation which is involved in any aspect of the food chain and wants to implement systems that consistently provide safe products.
SABS 0330	2006	Requirements for a Hazard Analysis and Critical Control Point (HACCP) system	Contains the requirements for the development, implementation and maintenance of a HACCP system as a preventative food safety system.
SABS 22004	2006	Food safety management systems – guidance in the application of ISO 22000;2005	Provides generic guidance that can be applied in the use of ISO 22000.

The South African Bureau of Standards (SABS) has produced a number of guidelines and standards relating to the handling of food, summarised in Table 2.2 (Oldewage-Theron & Fuller 2008: 648).

Food safety, particularly food preparation in bulk or in a mass catering unit requires strict regulation. In South Africa, food safety is regulated by strong legislation conforming to both local and international standards and is controlled by the Directorate of Food Control which subscribes to the CODEX principles (Oldewage-Theron & Fuller 2008:646-647). In the food industry all units are unique; to ensure the best consumer protection it is important to develop a standard that will fit and which is adaptable to all food industries.

2.5 SENSORY EVALUATION

2.5.1 Introduction to sensory evaluation

Food quality is evaluated by all people, either consciously or unconsciously. The choices of food in the food market are made by consumers, based on their previous experiences with specific brands and various foods. Consumers' at-home evaluations of products determine whether or not they buy a particular item again. Their selections serve as an endorsement or proof of consumer acceptance, which then tells the food manufacturer that this quality level is preferred over that of similar products in the marketplace. Thus the individual consumer's evaluation of food, combined with the decisions of countless other individual consumers, dictates the quality of food to be produced in this nation (Stone & Sidel 2004:33)

Testing of food quality in the marketplace is too costly for food producers to undertake on a broad basis without considerable preliminary research. In-house testing and evaluation are done on a scientific basis, with food scientists planning and supervising

experiments. Very careful and thorough tests are conducted to ascertain the product formulations or processing techniques that are anticipated to be successful in the marketplace (Stone & Sidel 2004:33).

What does sensory evaluation really measure? To the naïve and relatively inexperienced individual, the simple answer would be “anything that can be analysed by the senses” (Gatchalian 1981:6). Certain information can be derived simply by the use of senses in whatever manner one deems best to achieve one’s objectives. But haphazard application of the process is like treading in deep waters. One may find that results obtained can be most misleading if not altogether useless. It is important that if one’s intention is to utilise the techniques of sensory evaluation, one must be prepared to accept the requisites attendant on the concept. In short, one must know exactly what is expected to be measured (Gatchalian 1981:6).

Although the majority of research and discoveries in the field of sensory evaluation converges greatly on the area of food, only sensory tests can be utilized for qualities measurable by the human senses. Thus, texture measurements could be applied to non-food items; smell, for perfumes, lotions and soap. Colour, gloss, size, shape and general appearance, defects and other sensory attributes of materials other than food can also be measured by procedures utilized in sensory evaluation (Gatchalian 1981:6).

The role of sensory evaluation relative to activities in the manufacture of a product is shown in Figure 2.2. The outer circle shown in Figure 2.2 is the Gatchalian’s original concept of the relationships between the four potential users of sensory evaluation approaches (Gatchalian 1981:7).

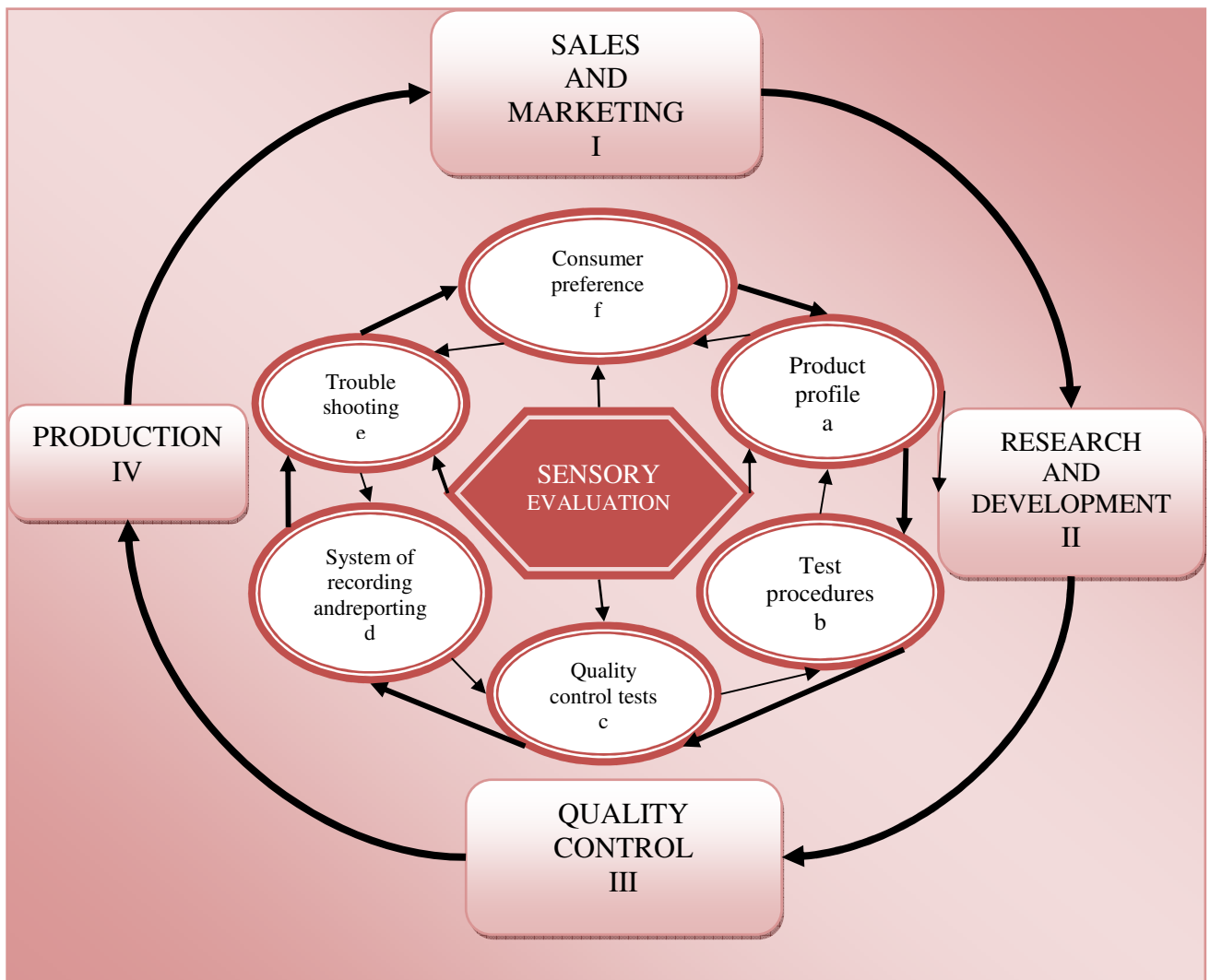


Figure 2.2 The role of sensory evaluation relative to activities in the manufacturing of a product (adapted from Gatchalian 1981:7).

The idea is that any consumer product worth developing, as observed by the Sales and Marketing group (I), must first be characterised physically chemically and sensorially, resulting in a product profile (see the inner circle in Figure 2.2). Involved in the latter would be identification of properties which would most likely cater to consumers' demands. Once identified, test procedures (see Figure 2.2, b) could be developed in

such a way that chemical and physical properties may be correlated with the sensory properties identified through the product profile. There must be constant checking and validation of test procedures (see Figure 2.2, c), while adequate recording and reporting of all observed data must be carefully and religiously practiced (see Figure 2.2, d). Should trouble arise (Figure 2.2, e), this recorded information could easily be tapped to resolve the problem before the product is again released for the end-users or consumers. The arrows go two ways because consumer complaints could be a starting point for restudying product characteristics, identifying trouble areas (Figure 2.2, c), retracing reports and records (Figure 2.2, d), checking physicochemical tests (Figure 2.2, a) and eventually resolving the problem, resulting in a go-signal for product release to consumers. Note that all stages from a to e show how involved sensory tests can be (Gatchalian 1981:7-8).

2.5.2 Selection of panel members

Panel member selection should be based on the factors identified as important for the specific study. Laboratory research frequently requires careful discrimination in evaluation of products. The ability to detect the differences is essential if a panel member is to make meaningful contributions to the project. Preliminary testing to ascertain that potential panel members can discriminate on key aspects of the testing permits selection of a panel that is physically qualified to serve. This is important for tests requiring sharp discrimination about characteristics of samples (Stone & Sidel: 2004:48).

In the case of this study, preliminary testing was done with a group of professional people to obtain information about the product, because a consumer panel was used in the final case. The information obtained from the children was used for the final product development. The children acted as a consumer panel. A consumer panel for sensory evaluation is a panel selected from people who happen to be available at a test

site and are willing to participate. Consumer panels are often naïve panels. It should be understood that the term naïve in this context simply means that no training has been conducted with the panel and is in no way a reflection of the potential capability of the panellists. (Stone & Sidel 2004:48).

2.5.3 Hedonic Scale

Hedonic scales were primarily intended for use with children with limited reading and/or comprehension skills. Hedonic scales are also seen as a pleasure scale for rating food characteristics. Hedonic scales can be described as a series of line drawings of facial expressions ordered in a sequence from a smile to a frown, or they may depict a popular cartoon character. The facial expression may be accompanied by a descriptive phrase and may have five, seven, or nine categories. In some testing situations, a picture on the scorecard may prove to be worth quite a few, if not a thousand, words if the researcher is working with young children, with people who cannot read well, or with people who have very limited use of the English language, the language used by the investigators. A picture scale can prove to be invaluable in communicating the level of pleasure food brings to the panellist. Such a scorecard will have simple drawings of a face, with the expression being altered very slightly from one picture to the next to create a picture rating scale (Stone & Sidel 2004:64). Because children were used in this study, it is sensible to use a Hedonic scale. Of all scales and tests methods, the nine-point Hedonic scale occupies a unique niche in terms of its general applicability to the measurement of product acceptance-preference. An appropriate orientation is needed, so that the children understand the meaning of the different facial expressions and what their task will be. Very young children (six years and younger) can be distracted by the pictures, and can even be disturbed by the mean look of the frowning face (Stone & Sidel 2004:90; McWilliams 1997:64).

The scale was developed and described by Peryam and Pilgrim (1957). It was developed to assess acceptability of several hundred food items (Peryam *et al.* 1960), and since then has been reconfirmed by further studies of foods served to the military. As part of a larger effort to assess the acceptability of military food, these investigators studied a number of different scales of varying length and number of categories as well as selection of the most appropriate words used as the anchors of each category (Stone & Sidel 2004:87). These investigations demonstrated the reliability and the validity of the scale to a degree that has been especially satisfying. Of particular value have been the stability of responses and the extent to which such data can be used as a sensory benchmark for any particular product category (Stone & Sidel 2004:88; McWilliams 1997:62-64).

For computational purposes, these facial expressions are converted to their numerical counterparts and treated statistically, as in any other rating scale.

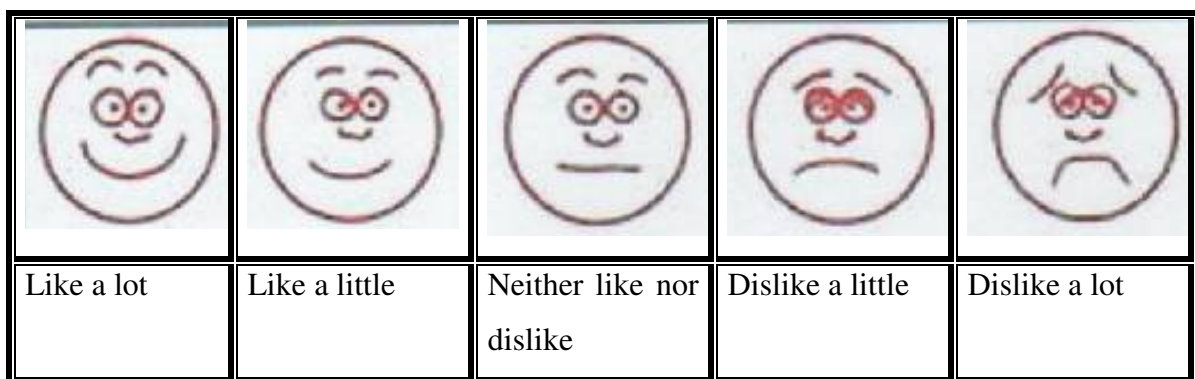


Figure 2.3 Example of facial expressions used in a Hedonic scale

In a study of flavourings for use with children's medication, it was observed that the children tended to use the happy smile portion of the scale because they thought that they should feel better after taking the medication. This information was derived from post-test interviews necessitated by the lack of differentiation of the products and a

desire by the investigators to reformulate the products (Stone & Sidel 2004:91; McWilliams 1997:64).

There is no question that children's testing is challenging. The ability to read and to comprehend test instructions is not uniform among children of the same age. This does not necessarily mean that typical scales cannot be used; rather, it suggests that some changes may be necessary in the test protocol and especially with the oral instructions given at the time of the test. It is interesting that the face scale would be proposed for use with individuals having limited reading and comprehension skills when one of the basic requirements of its use is the ability to interpret reaction to a product represented by a face. There is no question that with instructions some children can learn the task. However, this would defeat the claimed, primary advantage for the scale – the ease with which it can be used by the child. Finally, if one must train an individual to use a scale, it would be more reasonable to work with a scale that does not require transformations. When working with children eight years and older, reliable acceptance information can be obtained using the nine-point Hedonic scale provided all the children can read and, most important, can understand the meaning of the words. It should not be a surprise that many adults also do not understand the meaning of all the statements. However, this is overcome through an appropriate orientation such that the children and adults develop an understanding of the scale's direction and what their task will be (Stone & Sidel 2004:91-92).

2.6 CHEMICAL ANALYSES OF FOOD ITEMS

Chemical analyses (Table 2.3) to determine the actual nutrient content of a food item must be done by people specialising in chemical analysis with special equipment in a laboratory with the necessary safety procedures. The most common chemical analyses used for nutritional content, also used in this study, are described briefly as follows:

Table 2.3 Methods of chemical analyses of products to determine the nutrient content (Oldewage-Theron and Amuna 2002)

Nutrient	Method	Basic Principle
Protein	Total Kjeldahl digestion method. Modified Berthelot reaction	Acid is used to release nitrogen from the sample, which is then measured and used to derive protein value by using a conversion factor.
Fat	Acid – hydrolysis	Hydrochloric acid is used to digest the sample of fat and ether is added to dissolve the fat.
Ash	Direct	Organic matter is removed by heating the sample in a furnace at 550°C.
Moisture	Drying	Water is evaporated by drying the sample in an oven at 105°C.
Carbohydrate	Derived	100 % - (% protein + % fat + % ash + % moisture).
Energy	Derived	(Protein x 16,8 kJ) + (Carbohydrate x 16,8 kJ) + (Fat x 37,8 kJ).
Minerals (Ca and Fe)	Atomic absorbance spectroscopy (AAS)	Sample is digested in acid to release minerals. AAS atomises sample then passes a beam of radiation through it. Absorption is measured at wavelength corresponding to mineral of interest.
Minerals (Cu, Mg and Zn)	Inductively coupled plasma mass spectroscopy (ICP-MS)	Sample is digested in acid to release minerals. ICP – MS ionizes sample, then separates ions according to mass and counts the ions.
Vitamins (B's, A, C and folate)	High performance liquid chromatography (HPLC)	A procedure for the separation of non-polar solutes. Non-polar solutes are chromatographed on a column having non polar liquid immobilised on an inert matrix. A more polar liquid that serves as a mobile phase is passed over the matrix, Solute molecules are eluted in proportion to their solubility.
Vitamins (other)	Theoretical calculations	South African food composition table and food Finder/Dietary Manager®.

2.6.1 Proximate analyses

To determine protein, fat, ash, moisture and carbohydrate content a proximate analysis must be done.

2.6.1.1 Energy determination

Applying the Atwater factors, an estimate of the energy content of food samples can be derived assuming that 1 g each of carbohydrate and protein will yield the equivalent of 16.8 J, and 1 g of fat is equivalent to 37,8 J (Zotor 2006:2-8).

2.6.1.2 Protein digestion and Kjeldahl protein analyses

Equipment needed to conduct these analyses, includes analytical balance, boiling tubes (25 x 300 mm), a 40-place standard heating block, Spectrophotometer and various consumables, including certified reference materials (Zotor 2006:2-8).

2.6.1.3 Nitrogen determination

Two techniques are employed to determine nitrogen content of digested samples. Both techniques involve the use of the modified Berthelot reaction. One method involves an automated technique and the other one a manual technique (Zotor 2006:2-8).

2.6.1.4 Fat determination

The acid hydrolysis method (adapted from the AOAC Official method 922, 06), is used in fat analysis (Zotor 2006:2-8). Another method for fat determination is method 920.39C where a soxhlet apparatus is used (Marsh 1983; Powers & Hover 1989).

2.6.1.5 Ash determination

The ash content of food products is determined by weighing the dry residue of foods after heating at elevated temperatures of 550°C to remove any organic matter, leaving the inorganic ash fraction of the sample as described by Pomeranz and Meloan (1994). Equipment needed is a six-place hot plate to first burn the samples into soot and also a muffle furnace to transform the soot into ash (Zotor 2006:2-8).

2.6.1.6 Moisture determination

An oven is used in determining the moisture content of individual ingredients in food samples. With the use of a thermometer, the heating (oven) temperature for each procedure will maintained at 105°C for a period of five (5) hours (Zotor 2006:2-8).

2.6.1.7 Carbohydrate determination

Total carbohydrate content (which includes crude and dietary fibre) is derived from the difference between the total original weight of a sample and the weight of protein, fat, ash and moisture as determined above (Zotor 2006:2-8).

2.6.1.8 Micronutrient analyses

Atomic absorption spectrometry (AAS) and inductively coupled plasma mass spectrometry (ICP-MS) can be employed in the determination of the mineral content of food samples. Most vitamins are determined by High Performance Liquid Chromatography (HPLC) (Zotor 2006:2-8).

2.7 SHELF LIFE MEASUREMENTS

“Shelf life is that length of time that food, drink, medicine and other perishable items are given before they are considered unsuitable for sale or consumption. In some regions, a best before, use by or freshness date is required in packaged perishable foods” (Wikipedia 2008:1). Shelf life represents the time that food is still useful for human consumption before the food starts to develop characteristic changes in taste, aroma texture and appearance that are deemed unacceptable or undesirable or until it cannot be used by humans, or is no longer safe for human consumption. The underlying cause of the change may be microbiological, chemical or physical. Freezer burn can also be added to the examples of chemical and physical deterioration. Food is a chemically complex matrix and predicting whether and how fast microorganisms will grow in any

given food is difficult. All foods contain sufficient nutrients to support and increase microbial growth (USFDA 2001:3).

There is a difference between shelf life and expiration date; shelf life relates to food quality, and expiration date to food safety. A product that has passed its shelf life tests might still be safe for human consumption, but the quality of the food is no longer guaranteed, since in some cases taste and texture changes may occur. In some of the food stores, shelf life is maximised by using stock rotation, which means they pack the products in such a way that the products with the earliest dates are in the front of the shelf, meaning that most shoppers will pick them first; in this way they get them out before the expiration date. This is important, as some stores can be fined for selling food products past the expiration dates, or they have to mark such products down and that can lead to loss of profits (Wikipedia 2008:1).

Products that must be refrigerated must be stored in the refrigerator and products that have to be at room temperature should be stored at ambient conditions. Small changes in storage temperature may have a significant effect on the shelf life of the product. A few degrees may determine the difference between good shelf life and premature spoilage. Refrigerator and room temperatures may differ and to produce a meaningful study, temperatures must be known. This is most easily accomplished if the study temperatures are fixed and not varied (Curiale 1998:2).

2.7.1 Selecting criteria to assess shelf life

First, some criteria that change with time and that are appropriate for the product must be selected. Changes for these criteria can be measured with respect to time. Microbiological criteria may be chosen, for example, with chilled food; total plate count, psychophysics counts, or counts of specific microorganisms for public health or economic significance may be monitored for the estimation of shelf life. The loss of

some nutrient such as vitamin C might be identified or the loss of some functional property of the product, such as its ability to whip, to colour, to foam, or to leaven might easily be picked. The progressive gain of some undesirable textural change, such as hardening or softening or staling, can be the criterion for assessing shelf life. Loss of crispness in potato chips can be the mark of a loss of quality, as can the development of graininess in a fondant or in an ice cream (Fuller 2004:134).

Selection of any of the above criteria for stability presents different degrees of complexity for developers. It is comparatively simple to follow the destruction of a nutrient like vitamin C in a food. But if that new food is not an important or even significant source of vitamin C, then vitamin C is not, in all likelihood, a useful criterion for monitoring shelf life. If the loss of vitamin C correlates closely to the loss of a major quality characteristic of the new food product that is difficult to measure, then vitamin C is a good standard (Fuller 2004:134).

Most foods are complex systems of components and cannot usually be judged for quality on the basis of one characteristic. It is noted that only one quality characteristic of a food is adversely affected during its shelf life. It is more likely that colour, texture, and flavour will all degrade over time and at different rates. Therefore, choosing the correct criterion or criteria to follow during the determination of shelf life stability becomes very important (Fuller 2004: 134).

A good example is that temperature influences the rate of chemical reactions. The familiar Q_{10} states that for every 10°C increase in temperature, one can anticipate a two- to fourfold increase in the rate of a chemical reaction. This influence of temperature on rate can be seen in the work of Labuza and Riboh (1982), who reviewed the influence that abusive temperature treatment can have on Arrhenius kinetics with respect to nutrient losses used as the predictor of shelf life of foods (Fuller 2004:134; Labuza & Riboh 1982:66-75).

Temperature changes will cause phase changes in foods. Gels and emulsions will break down, ice will thaw, or ice crystals can grow and damage the structural integrity of soft food. Texture or tackiness of foods will alter (Slade & Livine 1991; Goff 1992; Fuller 2004: 137).

Temperature changes affect biological reactions; such changes can alter growth rates and growth patterns of microorganisms and the activity of enzymes (Thorne 1986; Williams 2004; Fuller 2004:137).

Product development technologists have traditionally used three general approaches to determine shelf life:

- Static tests, in which the product is stored under a given set of environmental conditions, selected as most representative of the conditions to which the product will be subjected;
- Accelerated tests, in which the product is stored under a range of some environmental variable, for example, temperature; and
- Use/abuse tests, in which the product is cycled through some environmental variables (Fuller 2004:137).

2.7.2 Guidelines to determine shelf life

Determining a product's shelf life can be very difficult. Shelf life is an important characteristic of a food product that may be required by legislation or by contract between a co-packer and a buyer or insisted upon by a retailer. Consumers, at the end of the distribution chain, certainly expect food to have a good quality life until it is consumed no matter how long and under what potentially abusive conditions it was kept. At the starting point of the chain, manufacturers of sensitive food products, chilled foods for example, are at the mercy of distribution and warehousing companies and

depend on them to store and handle products under no abusive conditions (Fuller 2004:141).

2.8 RECIPE WRITING

Once a product is formulated, tested and meets all the set criteria, a recipe should be written for production. When preparing to write a recipe copy, the first question that arises is “What form should the recipe take?” Or “How is it best offered to the consumer or end user?” The most important consideration is to provide a recipe which is clear, easy to follow, concise and attractively presented (Hullah 1984:51).

Various styles of writing recipes have appeared. There are basically three common formats: standard, narrative and action.

2.8.1 Standard recipe format

The standard format is most commonly used in both cookbooks and promotional material. Within this format, ingredients are listed first, distinctly separate from the method. Metric and/or imperial measures appear on the left and/or right hand side. The method then follows in paragraphs or steps with the recipe yield clearly stated (Hullah 1984:52).

2.8.2 Narrative recipe format

The second format is often referred to as the narrative format. This pattern is best used when there are limitations on space or if the recipes are short and uncomplicated. The narrative format includes ingredients and measures in the method. It may be expanded for detail or condensed for casual recipe ideas and varied like the standard format. However, unless the recipe is particularly short and simple, this format can be difficult to present coherently (Hullah 1984:53).

2.8.3 Action recipe format

This recipe style incorporates elements of the narrative format with the standard format. An attempt is made to list clearly within the method statements the ingredients required for each particular method step. Although this style is easy to follow, it may take more space and can be difficult to arrange economically or attractively on paper, especially when using dual measures (Hullah 1984:54).

2.9 CONCLUSION

In this chapter product development, along with all its associated aspects such as analysing of the nutrients, shelf life and consumer acceptance was discussed.