Establishment of a trained sensory panel for quality assessment of meat products

By
H.M.S.C. Bandaranayake
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Department of Food Science and Technology
Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka
Buttala

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Declaration

The research work described in this thesis was carried out by my self at Keells food products Ltd. and Faculty of Applied Sciences under the supervision of Mr. Lasath Rathnayake, Assistant manager (quality assurance) of Keells Food Products Limited, and Mrs. Rasangi Sabaragamuwa, Lecturer, Department of food science of faculty of Applied sciences, Sabaragamuwa university of Sri lanka. A report on this has not been submitted to any other university for another degree.

H.M.S.C. Bandaranayake

..... 29.10.2007

Signature Date

Certified by:

Mrs. Rasangi Sabaragamuwa,
Lecturer,
Department of Food Science and Technology,
Faculty of Applied Sciences,
Sabaragamuwa University of Sri lanka,
Buttala

..... 29.11.2007

Signature Date

External Supervisors,

Mr. Lasath Rathnayake,
Assistant manager (quality assurance,)
Keells Food Products Limited,
No-16,
Minuwangoda road,
Ekala,
Ja-ela.

..... 29.10.2007

Signature Date

04-12-2007

Head/Dept. of Food Sciences & Technology
Faculty of Applied Sciences
Sabaragamuwa University of Sri Lanka
BUTTALA

AFFECTIONALY DEDICATED TO MY PARENTS & ALL MY TEACHERS

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ABSTRACT

Establishment of a panel for descriptive sensory analysis is a scientific approach of using human perception ability as a tool for quality assessment of foods. Meat is a major human food item with hundreds of different sensory attributes. To compete with other brands and to stay in the market the product has to be checked regularly for sensory acceptability. As the leader of the local processed meat industry, Keells food products limited wanted a well established sensory panel for descriptive sensory evaluation of their meat products. The study was targeted to establishing and training an internal panel for descriptive sensory analysis of sausage range products.

Among thirty three people twenty five were selected as the potential panellists by a pre-screening questionnaire and interview. In the screening test, the ability of assessors for detection and discrimination of sensory attributes of meat were tested by taste identification test, odour identification test, salt and spice level identification test and texture evaluation test. Then the selected twenty assessors were subjected to a training programme. The texture and flavour attributes of sausage range products were identified and defined clearly. The selected attributes were tenderness, juiciness, rubberiness, meatiness, spiciness, saltiness, hotness and odour. The assessors were trained to familiarize with those definitions, the sequence and specific points where the sensory attributes can be perceived. Then the assessors were trained with a modified score sheet for daily sensory evaluation. Finally, the assessors' performance was evaluated.

Almost all the assessors had previous experience of sensory evaluation. Few individuals were not selected from the pre-screening test due to lack of availability, special diets and health problems. Screening test showed that they had some problems with the texture evaluation and spice level identification. Most of the assessors had problems with the definitions of sensory attributes. The assessors were familiarized with the definitions of the sensory attributes of sausage range products in the training programme. The performance evaluation showed that the texture attributes were identified and discriminated correctly. There were problems with spice level identification. The results were analyzed using Analysis of variance. The results showed that the assessments of the panellists are not significantly different. So the established sensory panel can be successfully used for descriptive sensory evaluation of meat products.

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ABBREVIATIONS

App : Appendix
edt : Edition
et al. : And others
g : gram

CHAPTER 01

INTRODUCTION AND OBJECTIVES

1.1 Introduction

The Livestock sector is undergoing rapid changes in response to pressures from globalization and rapidly growing demand for animal food products in developing countries. New products from innovative thinking are developing each day and people are becoming variety seekers. On the other hand the same meat product comes in to market in different brand names. In that case quality of the product plays a major role in deciding the market.

When consider the quality aspects of meat products, the product should be with microbiological, chemical and sensory acceptability. By the law, or working with a quality management system, definitely the company has to fulfil the first two quality aspects (microbiologically, chemically) before releasing the product to market. The sensory properties of the food product must be within an acceptable range. Beyond that, it is not conformance to requirement or fitness for use. Therefore it is not comply with the quality requirements.

If we can predict the product sensory quality before release the product to the market above problem can be solved easily. On the other hand the sensory attributes may predict the microbiological and chemical conditions of the product. The best solution is having a trained sensory panel for sensory evaluation of the products before they issue to the market. A well trained sensory panel can assess the product sensory quality, or can change the product situation to acceptable level by proposing required changes and/or modifications. Other than quality control, a sensory panel can be useful in new product formulation studies, shelf life evaluations, product mappings and product matching.

Keells Food Products limited, which is the leading meat processing company in Sri Lanka, has already won their consumer acceptance as the best processed meat products including comminute meat products and battered and crumbed delicacies. In order to study there sensory quality variations to compare and compete with the other growing meat companies, the company wanted a well established sensory panel. Therefore this project was concerned on fulfilling that requirement by establishing a sensory panel on sensory evaluation of processed meat.

1.2 Objectives

Overall Objective:

- To establish a sensory panel for meat products analysis in keells food product limited.
- To train them for descriptive sensory analysis of meat products.

Specific Objectives:

- To establish a procedure for screening a new sensory panel for meat products sensory evaluation.
- To establish a program for training the selected members.
- To establish a procedure for daily sensory analysis.

CHAPTER 02

LITERATURE REVIEW

2.1 Introduction to meat industry

Meat is defined as the flesh and fat, skin, rind and sinew in amounts naturally associated with the flesh of an animal, or bird or fish which is normally used for human consumption and includes edible parts but that does not include permanent offal.(SLS 1218:2001)

Worldwide, pork is the most widely consumed meat; beef is second. Mutton and lamb, poultry, goat, venison, and rabbit are other common meats. As the world population increases, world meat production is also increasing with globalization and expansion of their market.

In 1995, for the first time, meat volume produced in the developing countries exceeded that of developed countries. Earlier in the same decade, China overtook the United States and the entire European Union of then 15 countries in terms of meat production. These events mark a substantial shift of the "centre of gravity" of livestock production, from the North to the South, from temperate regions, to tropical and sub-tropical environments. (FAO Livestock report 2006). This is changing rapidly. In the developing countries, per caput consumption of meat has doubled since 1980 from 14 kg/cap/year to 29 kg in 2002. (Table 2.1)

Table 2.1 Changes in consumption of animal products:

	Developing countries				Developed countries			
	1970	1980	1990	2002	1970	1980	1990	2002
Annual per caput meat consumption (kg)	11	14	19	29	65	75	82	80
Total meat consumption (million MT)	29	47	74	139	70	88	103	105

Source: (FAO Livestock report 2006).

Total meat supply has tripled from 47 million tons to 139 million tons over the same period. Developments have been most dynamic in countries that have shown rapid economic

growth, notably East Asia, led by China. China alone accounted for 57 percent of the increase in total meat supply in the developing countries. For all developing countries, imports only account for about 0.5% and 14.5% of total meat and milk supply. . (FAO Livestock report 2006)

When comparing meat production of developed countries, developing countries show rapid growth rate of the total meat production. This may shows the future potentials of this industry in developing countries. (See Fig 2.2)

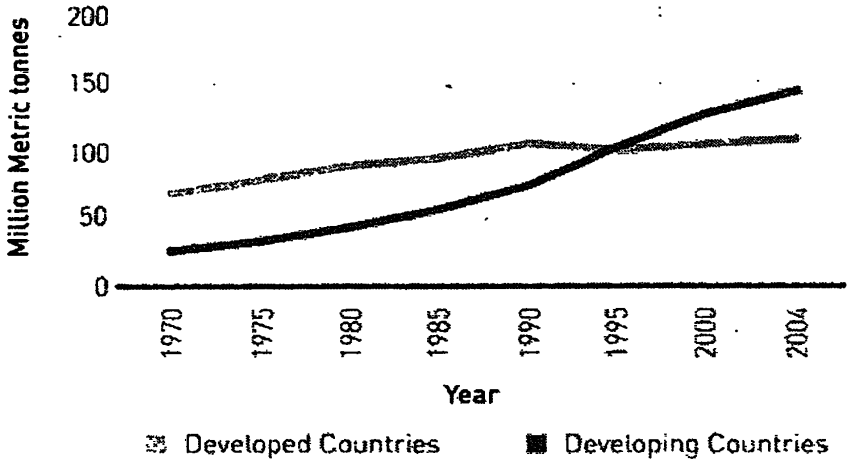

Fig 2.1 Meat production of developed countries versus developing countries
Source: (FAO Livestock report 2006).

When considering Sri Lanka condition of meat industry, the annual meat production and per capita meat consumption shows rapid increments. (App 02)

2.2. Sausages

Sausages are meat products that are salted and usually seasoned. The name is derived from the latin term *salsus* meaning salt. The manufacture of sausages began over two thousand years ago, and it is still a growing industry. There are some 800 types of sausage made of comminuted or chopped meat of various kinds, seasoned with salt and spices, often mixed with cereal and packed into natural casings (consisting of the connective and muscle tissue of animal intestines) or made of cellulose, collagen or synthetic materials. There are six main types of sausage - fresh, smoked, cooked, smoked and cooked, semi-dry and dry.

2.2.1 Ingredients used in sausages making

a) Meat:

Each type of meat contributes particular properties to the finished product. Raw materials are varying from their proximate composition, colour and connective tissue content and binding ability. Mechanically de-boned poultry meat, mechanically separated meat, used in sausages making. In recent years the use of poultry meat has had a significant impact on the production of sausages. (Kramlich et al., 1973)

The variety meat used in sausages making are heart, tongue, livers, kidney, tripe and pork stomachs. The proper selection of meat ingredients is essential for the production of sausages of uniform quality. Meat ingredients are vary based on their moisture to protein ratio, in their lean to fat ratio, water binding properties and relative amounts of pigments. Moisture to protein ratio of the meat material is important to the processor in predicting the composition of the final product. When processors use low moisture to protein ratio meat processor has to add more water to the meat. (Kramlich et al., 1973)

b) Ice or water:

Ice or water is added to the meat mass provide conciderable functional qualities. The ice or water chills the meat during chopping or mixing operations. This chilling permits larger and more efficient churning of the meat mass without mechanically overheating. This is accomplished by lowering the initial temperature and lubricating the meat mass. Added water aids in dissolving sodium chloride and curing salt to give better destribution in the mass. Water imparts fluidity to the emulsion or meat mixture. That aids in proper filling to the casings. Texture and tenderness of the finished product is affected by added water content. (Kramlich et al., 1973)

c) Salt:

Salt for the sausages should be of food grade quality. Salt serves in three functions in sausages.

- It dissolves in water to form brine which act to retard the microbial growth.
- It aids in solubility the mysosin type protein of comminuted muscle for emulsifying the fat in emulsion type sausages.
- It contributes to the basic taste charactoristics (Kramlich et al., 1973).

d) Curing salt:

Sodium, potassium nitrate and nitrite are generally called as curing salt. Added curing salt, in combination with moisture level, pH, added salt, and final internal processing temperature has a general bacteriostatic effect in the finished sausages. This also adds characteristic flavour. Function of curing salt in sausages making as follows.

- It prevents botulinum and has other bacteriostatic properties to get against mishandling of meat by manufacturers, retailing and consumers.
- It retards lipid oxidation.
- It gives cured flavour.
- Colour fixation of meat pigments due to cured pink colour. (Kramlich et al., 1973).

e) Phosphate:

It improves water binding properties of meat, solubalize of protein, act as an antioxidant and help to protect and stabilize the flavour and colour of the finished product. Through the use of phosphate, processors can expect a longer product shelf life and improves the smoke house yield. (Kramlich et al., 1973)

f) Ascorbate and erythrobate:

Ascorbate and erythrobate are strong reducing agents. They accelerate the conversion of metmyoglobin and nitrite to myoglobin and nitric oxide. These vitamin c derivatives are also known as cure accelerators, since they act to speed the curing process. Ascorbate and erythrobate inhibit formation of nitrosamine. Residual amount of these compounds present in the finished product also add stability to the cured colour by reducing the deterioration rate of the nitrosohemochrome pigments.

f) Antioxidants:

Several compounds may be added to fresh and dry sausages to retard the development of oxidize rancidity. Salt, light, a heating, freezing, and traces of certain metal all increase rancidity development. Most commonly used antioxidants are butilated hydroxyl toluene (BHT), butilated hydroxyl anisole (BHA), and propyl gallate. These compounds are used to prevent deterioration caused by fat oxidation.

g) Monosodium glutamate (MSG):

This is the sodium salt of glutamic acid, which is one of the common naturally occurring non essential amino acid found in protein. MSG blends out food taste without contributing any noticeable odour or taste.

h) Sugars:

A variety of sugars are commonly used in different sausage products. They are sucrose and dextrose. Main function of sugar is to provide substrate for the microbial fermentation in the fermented sausages. Most sugars increase the browning of the products. Dextrose is essential in the fermented sausages, because fermentation bacteria require a simple sugar to produce lactic acid.

i) Fat emulsions:

The source of fat as well as the condition of the fat can influence the stability of meat emulsion to lesser degrees. Rendered fat such as lard will produce unstable emulsion. When emulsion products are heated too rapidly, some fatting out occurred. This can be characterized by a greasy coating on the surface of the products.

j) Binders and extenders:

Binders and extenders are added to reduce the cost of the product and to provide certain functional properties. They are,

- To improve emulsion ability
- To improve slicing characteristics
- To improve cooking yield
- To improve flavour

e.g. cereal, starch, soy flour, soy protein concentrate, non fat dry milk, isolated soy protein.

k) Spices:

Many different spices, seasonings and flavourings are used in sausage product. Their use levels are identified by product identity, standards and personal flavour preferences. Spices are aromatic vegetable substances. In addition to effect up on the organs of taste and smell, spices stimulate the flow of digestive juices. Spices added as natural juices or as a spice extract. (Kramlich et al., 1973)

- **Chilli powder:** chillie has become the most widely used of all the spices. Flavor is intensity pungent, hot and sharp. It has a charactoristic aromatic odour with varies level of heat or pungency. The heat in all chillies, whether hot or mild, is due to the flavourless, odourless, colourless chemical known as capsaicin. (McGee, 2003.)

- **Black pepper:** Pepper is valued for its aroma bite.
  Bouquet: aromatic, pungent
  Flavour: Black pepper is very pungent and fiery.
  White pepper is less pungent.
  Green pepper is milder with a cleaner, fresher flavour.

- **Cardamom**
  Bouquet: Pungent, warm and aromatic.
  Flavour: Warm and eucalyptine with camphorous and lemony undertones. Black cardamom is blunter, the eucalyptus and camphor suggestions very pronounced. (McGee, 2003)

- **Cloves**
  Bouquet: Warm, pungent and aromatic
  Flavour: Sweetly pungent, astringent and strongly aromatic. (McGee B., 2003).

- **Nutmeg**
  Bouquet: sweet, aromatic and nutty
  Flavour: Nutty, warm and slightly sweet. (McGee B., 2003).

- **Cinnamon**
  Bouquet: sweet and fragrant
  Flavour: warm and aromatic (McGee B., 2003).

l) **Colourings:**

As a colouring agent in sausages making normally canthaxanthine is added. It obtained from special algae. It is a natural colouring substance. But extraction is done artificially.

2.3 Introduction to Sensory evaluation

Sensory evaluation is examination of organoleptic attributes of a product by the sense organs. (ISO 5492., 1992) It is the identification, scientific measurement, analysis and interpretation of the properties (attributes) of a product as they are perceived through the five senses of sight, smell, taste, touch and hearing. (Carpenter, *et al.*, 2000)

The field of sensory evaluation has grown rapidly in the second half of the 20th century, along with the expansion of the processed food and consumer products industries. Sensory evaluation comprises a set of techniques for accurate measurement of human responses to foods and minimises the potentially biasing effects of brand identity and other information influences on consumer perception. (Lawless et al., 1999) The valuable information which is collected by sensory evaluation can be used by product developers, food scientists and managers about the sensory characteristics of their products.

2.3.1 Importance and applications of sensory analysis

The established use of sensory analysis methodology will also convey an impression of professionalism, which will benefit the company in its dealings with its customers. Sensory analysis is used to answer questions about products quality, questions relating to discrimination, and description, or preference.

Discrimination is of particular relevance in the context of Product Quality Control, in shelf life studies, an in investigation of possible taints. These applications depend on the assessor's ability to detect and recognize differences.

Descriptive tests are more appropriate in the Product Development context, where there is desire to develop a product that matches a known target quality; or to reformulate an existing product using different ingredients processors; or to investigate the differences among a range of experimental and/or commercial products. (Carpenter, *et al.*, 2000)

a. Acceptability of a product before issuing it to the market.

The question that is asked is no longer an analytical one; instead it has to do with consumer judgment. It is no longer appropriate to recruit and train special assessors for the task-in fact any such training is likely to induce bias and be counterproductive. What is required is a group of respondents that is representative of target population of product users.

b. Shelf life studies of food products.

Shelf life study is done to find out how long a food product may be stored before there is an unacceptable deterioration in its sensory quality. During the shelf life of a product there are many factors that are likely affected its sensory quality, and ultimately, its acceptability to the consumer. For instance temperature, distribution and retail procedure and atmosphere are important factors.

c. Quality Control

A widely used definition of quality is in this context is "the collection of features and characteristics of a product or service that confer its ability to satisfy stated or implied needs" (ISO, 1992). When applied to a food product, this definition can be seen to comprise two "sensory" elements-the first part includes the objective sensory properties of the product ("the collection of features"), while the second part refers to the subjective perceptions of the end user or consumer of the goods ("to satisfy stated or implied needs").

d. Identification of taints

Taints can be odours or flavours that are essentially foreign to the food product, but have been inadvertently introduce by contact or exposure. This can lead to consumer complaints, or loss of repeat purchase, and some taints also represent health risks.

Sensory analysis is the best tool for identification of taint potential. It can establish whether taint problem is likely to develop, it can provide the first indication of taint problem.

e. Product matching

There are many brands of the same product. Sensory analysis uses to identify the differences and can use to develop the products and bring them to the front line among the best. This can use to track product development changes that aim to bring it in line with the sensory characteristics of another, similar products.

f. Product formulation

Sensory analysis provides objective tools for doing changes in manufacturing process. Descriptive sensory profiling provides an objective measure of any quality changes caused by ingredient or process substitutions.

g. Product acceptability

The question that is asked is no longer an analytical one; instead it has to do with consumer judgment. It is no longer appropriate to recruit and train special assessors for the task-in fact any such training is likely to induce bias and be counterproductive. What is required is a group of respondents that is representative of target population of product users.

2.4 Development of a sensory panel:

The recommended procedure involves,

I. Recruitment and preliminary screening of naïve assessors.
II. Training of naïve assessors who will become initiated assessors
III. Selection of initiated assessors according to ability to perform particular tests, they will then become selected assessors.
IV. Selection following the performance of an actual sensory assessment (usual in the case of descriptive analyses).
V. Possible training of selected assessors to become expert assessors.
VI. The performance of selected assessors should be monitored regularly to ensure that the criteria by which they were initially selected continue to be met (ISO 8586-1).

The following diagram shows how to train a new sensory panel:

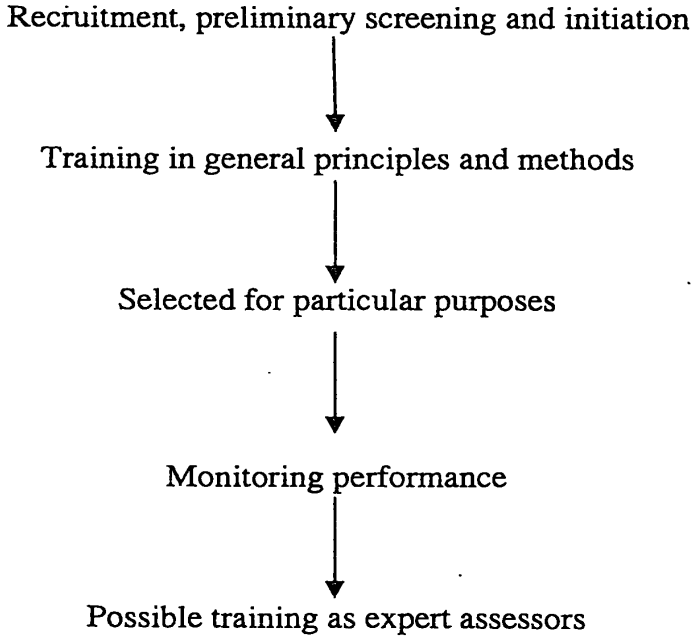

Fig 2.2 The process of training assessors

(Source ISO 8586-1)

2.4.1 Recruitment, preliminary screening and initiation

2.4.1.1 Recruitment

This is an important point of this development procedure for selecting the potential people. Different recruitment methods and criteria are available and there are various tests that can be used for screening candidates for suitability for further training.

The questions arise when recruiting persons to form a sensory analysis panel are,

- Where should one look for the people who will constitute the group?
- How many people shall be selected?
- How shall the people be selected?

Basically, there are two places to recruit people for the group.

a) Internal recruitment: Recruit people within the organization.

b) External recruitment: Recruit people from outside the organization.

a) Internal recruitment

People are recruited from the internal employers basically from office, plant or laboratory staff. When recruiting from the internal, It is advisable to avoid those persons who are too personally involved with the products being examined. For instance, those involved at the technical or commercial level, because they may cause the results to be biased.

Table 2.2 Advantages and disadvantages of internal recruitment:

Advantages	**disadvantages**
It is not necessary to make provisions for any payment	Effect on evolution of the organizations products is low.
Results can be kept confidentially.	Candidates are more biased in their judgments (by knowing of the products)
The panel is more stable with time.	Replacement of assessors is less due to limited number of people.
People are within the premises. So participation is easy	Lack of availability. (people have more works other than sensory evaluation)

b) External recruitment

The recruitment is conducted outside the organization. The cost for an external panel may higher than internal panel. Their judgment is less biased and evolution is high.

2.4.1.2 Pre-screening:

Background information on the candidates must be collected by a clearly understood questionnaires coupled with interviews by persons experienced in sensory analysis.

The following background information must be collected.

- **Interest and Motivation**

Candidates who are interested in sensory analysis and the product or products to be investigated are likely to be more motivated and hence are likely to become better assessors than those without such interest and motivation.

- **Attitudes to foods**

Strong dislikes for certain foods and beverages should be determined.

- **Knowledge and aptitude**

If the candidate is then required to evaluate only one type of product, knowledge of all aspects of that product may be beneficial. It is then possible to choose expert assessors from amongst those candidates who have shown an aptitude for sensory analysis of this product.

- **Health**

The candidates shall be in good general health. They shall not suffer from any disabilities which may affect their senses, or from any allergies or illnesses, and shall not take medication which might impair their sensory capacities and thus affect the reliability of their judgments. It may be useful to know whether the candidates have dental prosthesis, since they can have an influence in certain types of evaluation involving texture and flavour. Colds or temporary conditions should not be a reason for eliminating a candidate.

- **Ability to communicate**

The ability of candidates to communicate and describe the sensation they perceive when assessing is particularly important for considering candidates for descriptive analyses. This ability can be determined at the interview and again during screening tests.

- **Availability**

Candidates shall be available to attend both training and subsequent assessments. Personal who travel frequently or have continual heavy work loads are often unsuited for sensory work.

- **Personal characteristic**

Candidates shall be punctual in attending sessions and shall be reliable and honest in their approach.

- **Other factors**

Other information which may be recorded during recruitment are name, age group, sex, nationality, educational background, current occupation and experience in sensory analysis. Information on smoking habits may also be recorded, but candidates who smoke shall not be excluded on these groups. (ISO 8586-1)

It is necessary to recruit at least 2 to 3 times the number of persons actually required to constitute the final panel.

The number of individuals must be selected depend on,

- Financial means of the organization.
- Types and frequency of tests to be conducted.
- Whether the results are interpreted statistically or not.

2.4.2 Screening

Screening tests use to get an idea of the detection and discrimination ability of the individuals. The selected people from screen test can go to the training session.

Following two tests use to check Acuity and Discriminating ability

a. Test for detection of a stimulus

Triangular test is the recommended test. One material at a time is tested.

b. Tests for discrimination between level of intensity of a stimulus

Ranking tests are recommended to check discrimination ability of intensity of a stimulus.

2.4.3 Training of the panellists

The purpose of training is,

- Familiarize the individuals with test procedures
- Improve the individuals ability to recognize and identify sensory attributes
- Improve the individual's sensitivity to and memory for test attributes, so that sensory judgements will be precise and consistent.

Select and train extra panellists because approximately 20% drop out rate during initial phases of training, additional 20%drop out rate from then on due to: loss of interest, relocation, mortality. Initially the assessors shall be taught the correct way of assessing samples. The following aspects must be covered,

1. Instruction of techniques must be provided on,
    - Spit versus swallow.
    - How to rinse the pallet- Advantage of rinsing the mouth and of standard time intervals between samples shall be discussed.
      The interval between samples shall be sufficient to permit recovery but not so long that assessors lose their ability to discriminate.
    - Method and sequence of sensory evaluation of a sample. (App. 3)
    - How to use Scales and Score sheets?
2. Terminology or lexicon

3. Introduce reference samples and let them to identify reference attributes.

4. Concentrate on one attribute each session till familiar with that attribute.

5. The problem of adaptation and how to avoid it must be discussed.

Specific product training

After basic training, assessors may undergo training for assessing the particular product for difference or descriptive testing (visual, odour, texture and flavour evaluation).

2.4.4 Monitoring of selected assessors

It is necessary to check periodically the effectiveness and performance of selected assessors. The aim of check is to examine which individuals' performance to determine whether the selected assessor is able to achieve appropriate and reproducible results. The check may be carried out at the same times as the experiment itself in many cases. The results of this examination will indicate whether re-training is necessary.

2.5 Tests use in sensory evaluation

2.5.1 Discrimination or difference tests:

In this test, assessor compares two or more products indicating whether any differences exist. Some times they may be asked to describe the differences and estimate how large they are.

In difference tests, assessor has to find solutions for three questions:

- Does a different exist?
- How would you describe the difference?
- How large is the difference?

There are many types of difference tests and following are the most common ones.

- Paired comparison test
- Triangle test
- Duo trio test

Difference test may not the appropriate test for some products where the long carry-over effect is known to exist, or if the sample has to be held in the mouth for some time (e.g., chewing gum).

Sensory difference tests are relatively simple to perform, so they can be undertaken by trained, untrained, or consumer panels. But when using untrained panel, the number of assessors use must be higher than a trained panel. In a case of assessing a large number of samples, trained panels are more success because they are less likely to suffer fatigue. A consumer panel is more rarely use for difference testing.

2.5.1.1 Selecting the suitable test for a particular situation

- **Paired comparison (Difference) Test**

This is a type of directed test, which use to determine two samples are differing in a specified respect. The assessor is directed to a particular attribute or characteristic as the difference criterion. For instance, which sample is sweeter, or which is tendered.

The samples are coded and better to have unique codes for each assessor to minimize influence of one assessor by another. Test order must be standardized by ensuring that the both possible orders are tested an equal number of times. For this test recommended minimum panel size is of 20 members.

- **Duo-Trio Test**

This is used to identify whether any unspecified differences exist between samples. It is conducted as follows. The assessor is given a reference sample and two other samples which a one is similar to the reference sample. The assessor is asked to identify the similar sample.

- **Triangle Test**

Triangle test also use to determine whether an unspecified sensory difference exists between two treatments. Assessor is provided with three coded samples and asked to find the odd or different sample. (Here two samples are same and one is different). When presenting the samples all the possible combinations must be presented. The recommended minimum number is 18 assessors.

2.5.2 Descriptive tests

In this case assessor develops descriptors for a particular product and by using them, products differences are quantified. This is more developed procedure than the difference tests, which will need more trained assessors. First a sensory profile is developed, which is a set of ratings for the sensory characteristics of appearance, texture, odour, taste and after taste. There are two main stages in descriptive tests:

- Qualitative descriptive tests. – to identify sensory attributes
- Quantitative descriptive tests. – to assigning ratings/scores

Stage one is solely a qualitative where the assessor describes the product by words. This can only get a limited idea about quantity, by counting the number of times which a

particular attribute is described by the assessor. These frequencies can be useful in later stages when developing the sensory profile.

2.6 Flavour profile and Texture profile methods:

2.6.1 Flavour profile method:

2.6.1.1 Uses of flavour profile method:

- In the development, modification or improvement of food products
- In characterising the differences between products
- In quality control
- To provide sensory data for the interpretation of instrumental data
- To provide a permanent record of the attributes of a product
- To monitor changes in a product during storage (ISO 6564)

2.6.1.2 Principle:

The methods are based on the concept that flavour consist partly of identifiable olfactory and gustatory attributes and partly of an underlying complex of attributes not separately identifiable.

The methods consist of procedures for describing and assessing the flavour of a product in a reproducible way. The separate attributes contributing to the formation of the overall impression given by the product are identified and their intensity assessed in order to build up a description of the flavour of the product. (ISO 6564)

2.6.2 Texture profile method:

Texture is defined as all the mechanical, geometrical and surface attributes of a product perceptible by means of mechanical, tactile and, where appropriate, visual and auditory receptors. (ISO 5492)

2.6.2.1 Classification of texture attributes.

1) Mechanical attributes- these are the attributes related to the reaction of the product to stress. They are divided in five primary characteristics, i.e. Hardness, cohesiveness, viscosity, springiness and adhesiveness.

2) Geometrical attributes- those are the attributes related to the size, shape and arrangement of particles within a product.

3) Surface attributes- these are the attributes related to the sensations produced by moisture and/or fat content. In the mouth they are also related to the way in which these constituents are released. **(ISO 11036)**

2.6.2.2 Introduction to texture profile method:

Texture plays a major role when deciding a food is sensorial acceptable or not. Texture is perceived as a result of number of different attributes of a particular food. Theses textural attributes vary from one food to another. For instance, the textural attributes of comminute meat products are solely different from biscuits or any other bakery products. So developing a texture profile is very useful when performing descriptive sensory analysis.

Uses of texture profiles:

- Screening and training of assessors.
- Orientation of assessors through the development of definitions and evaluation techniques of textural characteristics.
- Characterization of the textural attributes of a product to establish a standard profile for the product in order to discern any changes later.
- Improving old and developing new products.
- Studying various factors which may affect the textural attributes of a product; these factors may be, for instance, a change in the process, time, temperature, ingredients, packaging or shelf life and storage conditions.
- Comparing a product with another similar product to determine the nature and intensity of textural differences.
- Correlation of sensor and instrumental and/or physical measurements. **(ISO 11036)**

2.6.2.3 Components of a texture profile:

- Perceptible textural attributes, i.e. mechanical, geometrical and others
- Intensity, i.e. the degree to which the attribute is perceptible
- Order of appearance of the attributes, which has five phases as follows.
    - Before mastication: i.e. all geometrical, moisture and fat attributes perceived from visually or by touch (skin/hand, lips).
    - 1st bite/sip: mechanical, geometrical and fat and moisture attributes perceived in the mouth.

- Masticatory phase: attributes perceived by the tactile receptors in the mouth during mastication and/or absorption.
- Residual phase: changes occurring during mastication and/or absorption, such as the rate and type of breakdown.
- Swallowing: ease of swallowing and description of any residue remaining in the mouth.

2.6.2.4 Major texture attributes:

a) Mechanical attributes- This can be divided in to five primary parameters and four secondary parameters when considering semisolid and solid foods.

Primary parameters:

Hardness: Mechanical textural attribute relating to the force required to achieve a given deformation or penetration of a product. In mouth, it is perceived by compressing the product between the teeth (solids) or between the tongue and palate (semi-solids).

Cohesiveness: Mechanical textural attribute relating to the degree to which a substance can be deformed before it breaks.

Viscosity: Mechanical textural attributes relating to resistance to flow.

Springiness: Mechanical textural attribute relating to the rapidly of recovery from a deforming force, and the degree to which a deformed material returns to its unperformed condition after the deforming force is removed.

Adhesiveness: Mechanical textural attribute relating to the force required to remove material that adheres to the mouth or to a substrate.

2ry parameters:

Fracturability (brittleness): Mechanical textural attribute related to cohesiveness and to the force necessary to break a product in to crumbs or pieces.

Chewiness: Mechanical textural attribute related to cohesiveness and to the length of time or the number of chews required to masticate a solid product in to a state ready for swallowing.

Gumminess: Mechanical textural attribute related to the cohesiveness of a tender product. In the mouth, it is related to the effort required to disintegrate the product to a state ready for swallowing.

b) Geometrical attributes- These attributes are perceived by tactile receptors. Tactile receptors are located in the skin, mainly in the tongue, mouth and throat. Geometrical attributes also discernable through the appearance of the product, whether food or not.

Granularity: This is a geometrical attribute which describes the size and shape of the particles in a food. This can be explained using attributes such as smooth, chalky, grainy, gritty and coarse.

Conformation: The perception of the shape and orientation of particles in a product is called as conformation. There are different kinds of conformations:

- Fibrous: long particles oriented in the same direction.
- Cellular: Highly organized structure composed of spherical ovoid particles, or composed of cell walls filled with a gas. (e.g. egg white foam)
- Crystalline: Refers to angular particles (e.g. Granulated sugar)
- Puffs: Hard or firm outer shells filled with large. Often uneven, air pockets (e.g. cream puffs, puffed rice)
- Aerated: relatively small, even cells filled with air and surrounded (usually but not always) by soft cell walls. (e.g. marshmallows)

c). Other attributes (moisture and fat contents)

These attributes related to the perception of moisture and fat contents of a product by the tactile receptors in the mouth cavity or on the skin. This is also concerned with the lubricating properties of the product.

Here, the properties like melting of the product contact with skin or in the mouth can be concerned. E.g. a piece of butter put in to the mouth and allowed to melt without chewing.

- **Moisture content:** it is a surface textural attribute which is perceived as the water absorbed by or released from the product. Popular terms include: dry (e.g. dry biscuit), moist (e.g. apple), wet, juice (e.g. orange)

- **Fat content:** it is a surface textural attribute which gives the perception of quantity or the quality of fat in a product. The total amount of fat content and its melting points as related to mouth coating attributes and geometrical attributes are also important.

As secondary parameters following parameters are important:

- Oily – the perception of soaking and running fat
- Greasy – the perception of exuding fat (e.g. bacon, chips)
- Fatty – perception of high fat proportion in a product, without exudation (e.g. lard, tallow).

2.6.2.5 How to develop terminologies for texture profile:

Panel evaluate samples with wide variation with the standard sample of the interested product. Assessors are provided with a broad range of attribute definitions at the start of the evaluation. Then assessors list all the terms which are applicable to one or all of the samples. These are discussed under the direction of panel leader and a mutually acceptable list of terms and definitions are selected.

When selecting terms following points should be considered:

- Check whether the terms represent all the characteristics relevant to the product.
- If there are any terms that are similar can be combined or deleted.
- Check whether all members agree with the terms and their definitions.

2.6.2.6 Establishment of an evaluation technique:

When developing a standard technique for evaluating the food, the normal procedure of consuming the product is considered and scientifically describe.

- How the food is introduced in to the mouth (e.g. bitten with incisors, removed from spoon by lips, or place whole in the mouth.)
- How the food is broken down (e.g. chewed with the teeth only, manipulated between tongue and palate, or it is partially broken down by tongue and then manipulated by the tongue to complete the breakdown.
- The condition of the food prior to swallow. (e.g. is the food swallowed as a liquid, semi solid, or particles suspended in saliva?)

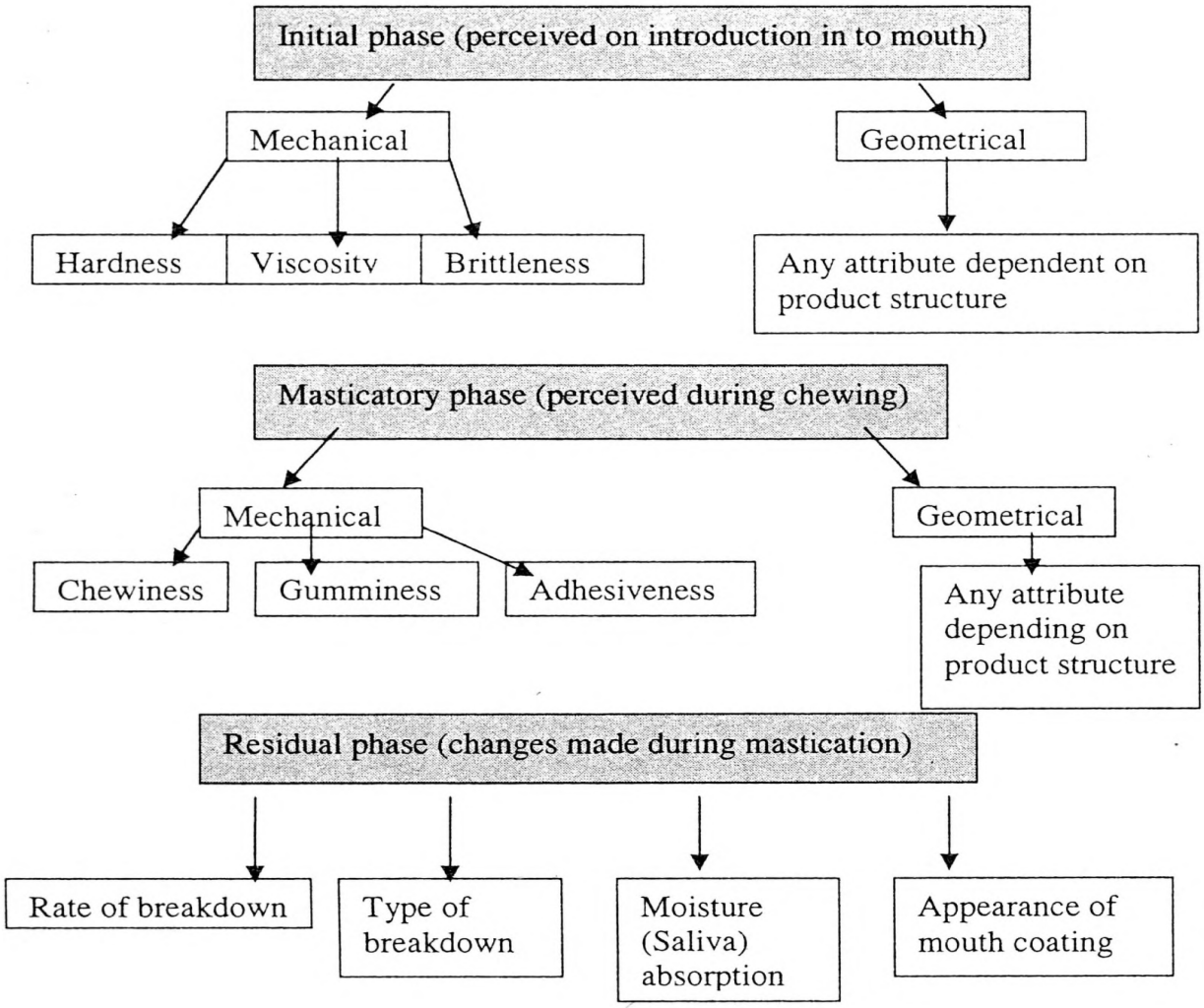

Figure 2.3- Example of a procedure for evaluating texture

Source (ISO 11036)

CHAPTER 3

MATERIALS AND METHODOLOGY

3.1 Materials

Raw meat: Chicken, Beef, Mutton, Pork

Salt (Nacl)

Spices: Black pepper

White pepper

Chillies

Ice or water

Curing salt

Phosphate

Fat emulsions

Binders and extenders

Antioxidants

Colourings

Instruments and Equipments

Mincer

Bowl chopper

Stuffer

Smoking trees

Peeling and packing mechines

Thermometers

3.2 Methodology

There are four major steps in establishment of a sensory panel.

3.2.1 Pre screening test:

As the company requirement, an internal recruitment was selected for the project. For pre-screening the assessors following basic requirements were considered.

- Health condition- Allergies, Special diets (Diabetic, High caloric, low caloric, low salt etc.)
- Interest
- Previous experience of sensory evaluation
- Attitudes
- Time availability

The test was conducted using pre prepared questionnaire by face to face interviews and also distributing the relevant questionnaire (App-4). Thirty three people were selected for pre-screening test. Their preferences were questioned and selection was done under favourable reply. The individuals were selected for pre-screening tests from management level, laboratory staff, production process, Marketing division and Accounting section of the company.

3.2.2 Screening test:

The selected candidates from the pre- screen test were subjected to screen test to verify their detection and discrimination ability. The basic taste and odour identification tests were not conducted due to almost all the people had previous knowledge and experience in sensory evaluation. The screen test was targeted to select the potential individuals, who have the ability to identify basic meat types, Spice and salt levels, odours and textures.

3.2.2.1 Meat type identification test:

This test was designed to assess the identification ability of different meat types by its taste. This was the most primary stage and those who were not able to identify them were considered as not suitable for the next steps.

The following four basic meat types were selected to test. They were made in to meat balls manually.(Figure 3.1)

Meat types: Chicken, Beef, Mutton, Pork

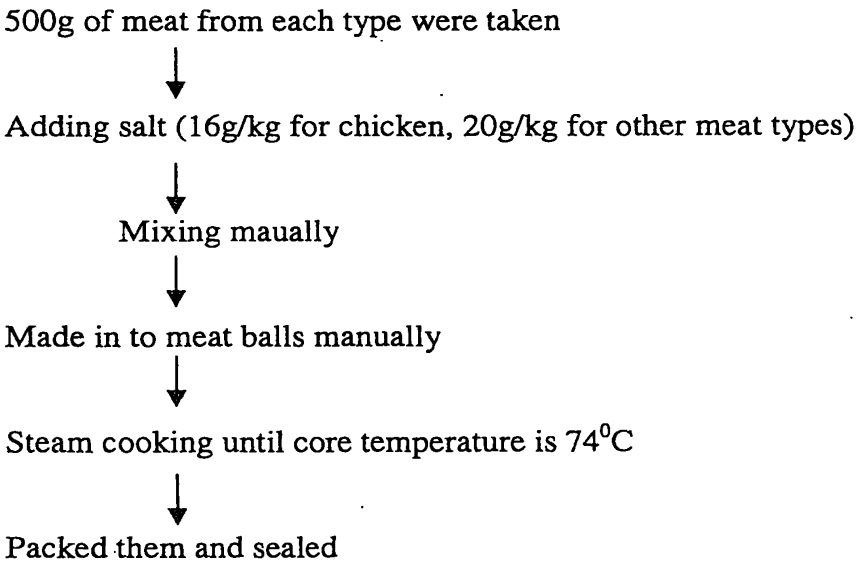

Figure 3.1 Sample preparation procedure

Assessment procedure:

Four meat types were labelled by 3 digit codes and allowed to identify (samples were again steam cooked until core temperature is about 60^{0}C). Sample order was randomized to get all the possible combinations. Assessors were asked to rinse the pallet with water at the beginning and between two samples and eat a cream cracker to neutralize the taste buds. The responses were asked to mark in the ballot sheet (App.05) after tasting the each sample. The persons who identified all four meat types were subjected to the next screening test.

3.2.2.2 Meat odour matching test:

All meat types has their own characteristic odours. This test was designed to assess the identification ability of different meat types by its characteristic odours.

The following four basic meat types were selected to test.

Meat types: Chicken, Beef, Mutton, Pork

Sample preparation procedure:

The same samples from test 2.1 were used for odour identification test.

Assessment procedure:

Samples were steam cooked. Then they are presented in labelled odour bottles while they are in hot condition. Data were recorded using the same format (App 05). Score was given as the number of correctly identified samples.

3.2.2.3 Spice level and salt level identification test:

This test was designed to assess the discrimination ability of assessors to different salt and spice levels.

Sample preparation procedure for spice level identification test:

Following three spices were selected for the test as they are the most commonly used spices for the real productions.

- Black pepper
- White pepper
- Chillies

Black pepper, white pepper:

Black pepper and white pepper were mixed with boneless chicken separately as 2g/kg, 4g/kg and 6g/kg and made six different samples of meat balls. (Salt 20g/kg also added) These levels were selected as designed by the research and development of KFPL by previous experiments.

Chillies:

Chilly powder was mixed with boneless chicken as 4g/kg, 5g/kg and 6g/kg and made three different meat balls samples. (Salt 20g/kg added)

Sample preparation procedure for salt level identification test:

Salt was mixed with boneless chicken as 13g/kg, 16g/kg and 19g/kg and made in to meat balls manually and packed and freeze.

Assessment procedure:

Steam cooked samples were presented with three digit codes and randomized to get all the possible sample orders (App 06). Then assessors were asked to identify the odd sample where two samples are same and one is different.

Due to poor discriminating ability of assessors another test series was designed as follows.

Sample preparation procedure for spice level identification test:

White pepper was mixed with boneless chicken as 4g/kg and 7.5g/kg and made two different samples of meat balls. (Salt 18g/kg also added).

Sample preparation procedure for salt level identification test:

Salt was mixed with boneless chicken as 18g/kg and 22g/kg and made two different types of meat balls. Assessment procedure is same as the method in attempt one.

3.2.2.4 Texture and tenderness identification:

Sample preparation:

Chicken meat was selected and prepared in to 3 levels of texture. The texture was changed by changing bowl-chopper number of chopping turns. Number of chopping turns used was twenty, forty and sixty turns. These levels also previously identified levels by research and development of Keells Food products limited..

Assessment procedure:

The samples were coded with three digit codes and assessed by triangle test (App 06).

3.2.3 Training and Orientation of the selected assessors:

There were four steps,

a) Identification of texture and flavour attributes of Sausage products.

The sensory attributes of sausage range products were identified and defined clearly depending on surface, geometrical and mechanical characteristics.

b) Developing the steps for sensory analysis of Sausage products.

A programme of step by step sensory analysis was designed. This programme was developed by targeting following points.

- What is the texture and flavour attributes of sausage range meat products?
- How we perceive those attributes?
- What is the sequence of perceiving them?
- What are the methods of testing those attributes? (App 07)

C) Training programme.

The major attributes selected above were targeted in the training programme. Five types of chicken sausages were made by varying following attributes.

I. Tenderness
- More tender sausage sample
- Standard sausage sample
- Less tender sausage sample

II. Juiciness
- More juicy sausage sample
- Standard sausage sample
- Less juicy sausage sample

III. Saltiness
- High salt sausage sample
- Standard sausage sample
- Low salt sausage sample

IV. Spices
- More spicy sausage sample
- Standard sausage sample
- Less spicy sausage sample

Sample preparation:

Five samples of chicken sausages were planed as follows, to represent variations of above attributes.

Sample 1= Standard chicken sausage of the company.

Sample 2= A chicken sausage was made with 0.3% low salt and 10% low spice than the sample one.

Sample 3= A chicken sausage was made with 0.3% high salt and 10% high spice than the sample one.

Sample 4= A chicken sausage was made by increasing the fat from 3% from the sample one.

Sample 5= A chicken sausage was made by decreasing the fat from 3% from the sample one.

Training procedure:

Twenty assessors who were selected from the previous steps, trained to above programme. A leaflet of the assessing procedure was given to each assessor and let them to assess different samples according to the procedure.

Training Session one:

Sample one, two and three were presented to the assessors with their identification information and let them to get familiar with the procedure. They were asked to identify the salt and spice variations of the sample two and three, with the standard chicken sausage sample (sample 1).

Training Session two:

Sample one, three and four were presented to the assessors with labelled as high fat, low fat and standard samples and asked them to familiarize with the differences.

d) Training the Score sheet:

The modified form of sensory evaluation check list was introduced to the panel and let them to familiarize with the scoring procedure. (App 08)

3.2.4 Performance Evaluation

Sample preparation

Sample 1= Standard chicken sausage of the company.
Sample 2= A chicken sausage was made with 0.3% low salt and 20% low spice than the sample one.
Sample 3= A chicken sausage was made with 0.3% high salt and 20% high spice than the sample one.
Sample 4= A chicken sausage was made by increasing the fat from 5% from the sample one.
Sample 5= A chicken sausage was made by decreasing the fat from 5% from the sample one.

Procedure:

Above five samples were evaluated using the sensory evaluation check list (app 8), with two replicates of each sample. The data were analyzed using analysis of variances (ANOVA).

CHAPTER 04

RESULTS & DISCUSSION

4.1 Pre-Screening tests

This test was planed to get individuals who are interested, highly available and with a sound health condition to perform sensory evaluations. The following information was collected using previously prepared questionnaire and interviewing the individuals.

Table 4.1 Results of pre-screening test

Assessor	Disagreed foods	Special diets	Availability	
			Day	Time
1	None	None	Week days	Not specified
2	None	None	Week days	Not specified
3	None	None	Week days	Week days
4	None	None	Wednesday	8-12a.m
5	Pork, Beef	None	Friday	2-3p.m
6	None	None	Week days	Not specified
7	Beef	None	Monday Tuesday Wednesday Thursday Friday	11-12a.m 2-4p.m 9-10pm 2-4pm 3-5pm
8	None	None	Week days	Not specified
9	None	None	Monday Thursday	10a.m 10a.m
10	Pork, Beef	None	Week days	10a.m
11	None	None	Week days	Not specified
12				
13	None	None	Week days	Not specified
14	None	None	Week days	Not specified
15	None	None	Week days	12.2p.m
16	None	None	Week days	Not specified
17	None	None	Monday	10a.m
18	Beef, mutton, lamb	Low calorie	Week days	Not specified
19	Beef	None	Monday Friday	12-4p.m 12-4p.m
20				
21	None	None	Monday	12-2p.m
22				
23	None	None	Friday	10a.m
24				
25				
26	None	None	Week days	Not specified
27	None	None	Week days	Not specified
28	None	None	Week days	Not specified
29	None	None	Week days	9-12a.m
30	None	None	Week days	Not specified

31	None	None	Mon	10a.m-2p.m
32	Pork	None	Week days	Not specified
33	None	None	Week days	Not specified

Table 4.2 Summery of the results of pre-Screening test:

Eating category	Eat all meats	Reject Beef	Reject Pork	Reject Mutton	Reject Lamb	Special diets
No. of people	25	6	2	1	1	1

By analyzing above data a panel of 25 people were selected for the next step. The people who reject two or more meat types were removed from the list. The highly available people were selected at the top. Two individuals rejected to participate for sensory evaluation.

4.2 Screening test:

The basic taste and odour discrimination tests were not conducted due to all candidates were experienced in sensory evaluation. So the screening tests were modified as follows.

The screening test was targeted to examine the discrimination ability of individuals to different meat types, and different spice and salt levels. In addition to that the assessors were tested to check their ability to identify different texture conditions.

The 1st attempt of salt and spice level identification test was given following results:

Salt test: Only 45% of assessors correctly identified the difference.

Spice test: Only 10% of assessors correctly identified the difference.

Due to lower ability to identify the difference, the second attempt was designed to increase the difference between samples.

Table 4.3 Results of Screen tests

Assessor	Taste	Odour	Texture	Salt	Spice	Total	Score%
1.	4	4	1	1	0	10\11	91%
2	4	4	1	1	0	10\11	91%
3.	4	4	1	1	0	10\11	91%
4.	4	4	1	1	0	10\11	91%
5.	4	4	0	_	_	8\9	89%
6.	4	_	0	1	1	6\7	86%
7.	4	_	0	1	1	6\7	86%
8.	4	2	1	1	1	9\11	82%
9.	4	4	1	0	0	9\11	82%
10.	4	4	0	1	0	9\11	82%
11.	4	2	1	_	_	7\9	78%
12.	4	2	1	_	_	7\9	78%
13	4	2	1	1	0	8\11	73%
14.	4	2	1	1	0	8\11	73%
15.	4	2	1	0	1	8\11	73%
16.	_	_	1	1	0	2\3	67%
17.	_	_	0	1	1	2\3	67%
18.	4	2	0	0	1	7\11	64%
19.	4	2	0	1	0	7\11	64%
20.	4	1	0	_	_	5\9	56%
21.	2	4	0	0	0	6\11	55%
22.	4	0	0	0	0	4\11	36%
23.	_	_	0	_	_	_	_
24.	_	_	1	_	_	_	_
25.	3	4	_	_	_	_	_

For taste and odour tests 4 marks were given if all the meat types were correctly identified. Three marks was given for any three meat types, and two marks for any two meat types and one is given for only one meat type was identified.

For evaluating the texture, salt and spice levels triangle test was done. One mark was given for correct identification.

a) Meat type identification test:

To be selected as a sensory assessor for meat products, the candidates must have a sound prior knowledge on basic meat types.

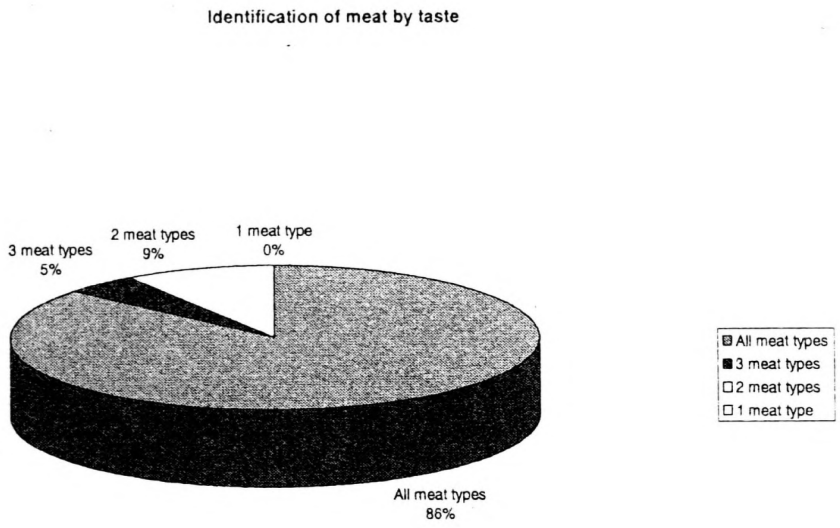

Figure 4.1 Identification of meat by taste

According to the results in screen test 86% of the assessors were able to identify all the four meat types (Chicken, Pork, Beef, and Mutton) by taste.

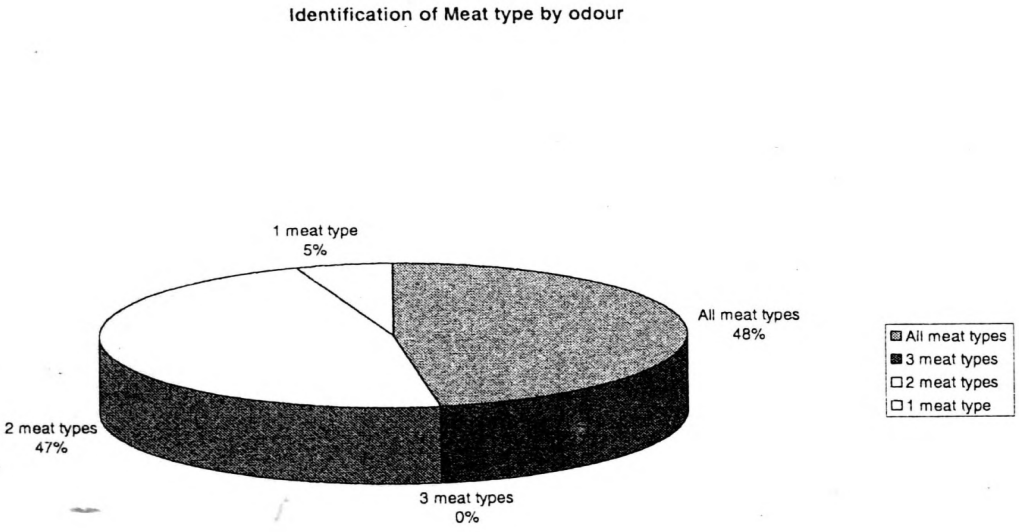

Figure 4.2 Identification of meat by odour

According to the results of meat type identification by odour test, only 48% of assessors were able to identify all meat types. This shows that, even though all assessors had

previous experience on sensory evaluation they may haven't considered much on meat odours.

b) Texture identification test:

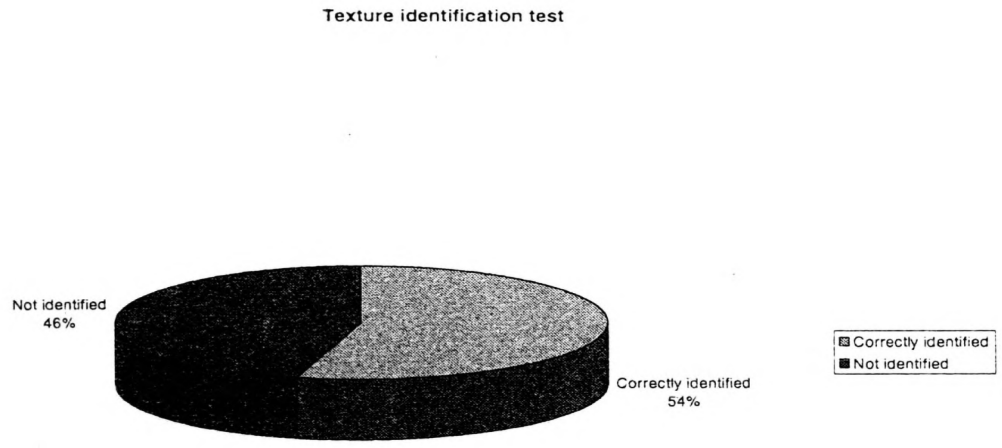

Figure 4.3 Identification of different texture levels

According to the results only 54% of assessors were able to identify the texture difference. Texture is a critical sensory attribute of sausages or any other meat product. This result showed that more consideration must be given to improve the discrimination ability of textural attributes. The texture was changed by changing the chopping levels of meat by the bowl chopper. This can change the fineness of the texture.

c) Salt levels identification test

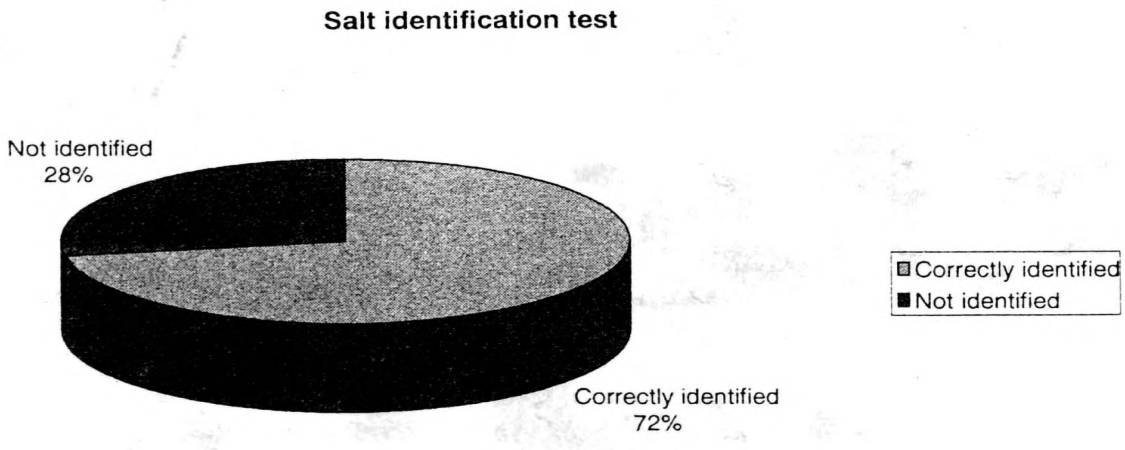

Figure 4.4 Identification of different salt levels

Salt level was correctly identified by 72% of assessors. Spice differences were only identified by 33% of people.

d) Spice levels identification test

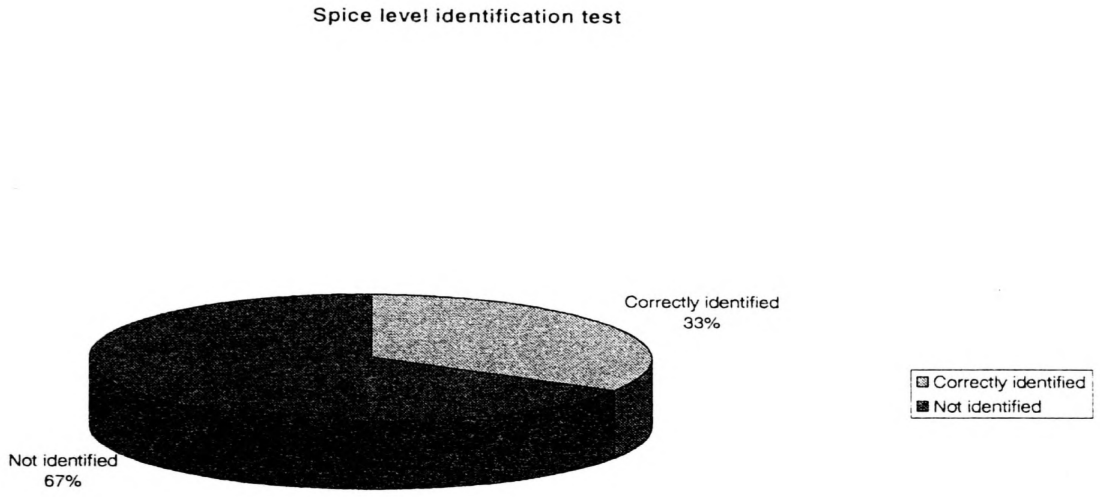

Figure 4.5 Identification of different spice levels

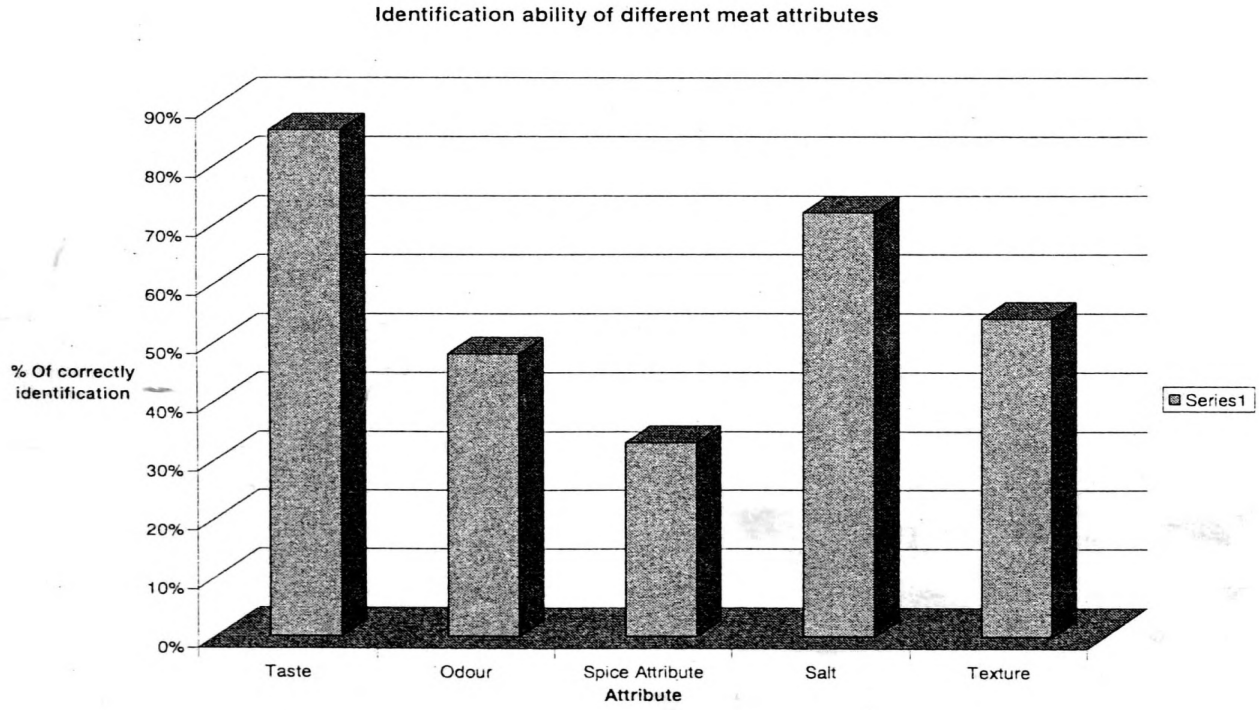

Figure 4.6 Identification ability of different sensory attributes of meat:

This graph shows that most of the assessors were able to identify meat taste and salt levels correctly but texture was identified by only half of the assessors. Spice level was identified below 40% of the assessors. These factors were concerned when designing the training programme.

4.3 Orientation and Training

4.3.1 Identification of texture and flavour attributes of sausage products.

The sensory attributes of chicken sausage were divided in to major three groups which are flavour attributes, appearance and texture attributes. The possible Mechanical attributes, Geometrical attributes and Surface attributes of sausage products were concerned. As mechanical attributes tenderness and rubberiness was selected. As Geometrical attributes size, shape and arrangements of particles within the product were concerned. As surface attributes colour, smoking level and shininess were selected. The same attributes also can be classified as follows.

As the flavour attributes meatiness, saltiness, spiciness, hotness and odour was selected. As the textural attributes of sausage products Tenderness, juiciness and Rubberiness was selected. As the outer appearance characteristics Shape and Size, Shininess of the surface, evenly smoked or not and Colour (Shiny golden colour) was selected. As the inner appearance fineness of the texture was selected.

4.3.2 Steps of sensory analysis of sausage products.

The sequence of receiving above sensory attributes was discussed with the assessors. Most of the assessors had previous knowledge of sensory evaluation. But as they commented, most of they did not have the knowledge of the sequence of receiving the attributes and what are the important points of receiving them. (App 07)

For instance the assessor can get an idea about the tenderness of the sausage in several points during the assessing process. e.g. Slicing, First bite, First chew, Chew down Some people (Management and marketing people) did not have the science background of sensory evaluation. By this programme they got the knowledge of doing a sensory evaluation with the scientific background.

These are some comments which were given by the assessors,

- This is a very good effort and tries to extend this activity to other range of products like battered and breaded products and specialized products.
- Try to publish the leaflet in sinhala medium too.
- It was very useful of providing the standard sample.
- This is a better procedure for doing a sensory evaluation step by step.

4.3.2 Modified check list for sensory evaluation:

The existing check list for sensory evaluation was modified as a clearer and easy score sheet where the assessor can give the score and do the evaluations step by step as the check list shows. For instance first the assessor has to check outer appearance of the product. So it is indicated in the first column in the check sheet with all the outer appearance characteristics.

4.4 Performance evaluation

After the training session a performance evaluation was carried out to check whether the assessors are well trained to the new process of evaluation and to check their discriminating abilities. In this test the responses to each and every attribute was tested separately to check their discrimination ability. All the attributes were taken separately and analyzed using Analysis of variance (ANOVA) by MINITAB. Then the responses were analyzed to check whether the assessors were able to discriminate the samples and responses between assessors are significantly different or same. If the assessors responses are significantly different each other they can't be used as correct sensory tools.

Following two tests were done to all attributes.

Test 1: h0: Three treatments are not significantly different from each other

h1: Three treatments are significantly different from each other

Test 2: h0: Responses of assessors are same

h1: Responses of assessors are significantly different from each other

Table 4.4 Summary of the performance evaluation

Attribute	Test 1(treatments)		conclusion	Test 2(assessors)		conclusion
	P value	F value		P value	F value	
Texture						
Tenderness (App 9)	0.000	38.31	Significantly different	0.319	1.22	Not significant
Juiciness (App 10)	0.000	23.72	Significantly different	0.884	0.47	Not significant
Rubberiness (App 11)	0.000	52.33	Significantly different	0.409	1.07	Not significant
Flavour						
Saltiness (App 12)	0.949	0.05	Not significant	0.135	1.69	Not significant
Spiciness (App 13)	0.380	1.00	Not significant	0.402	1.08	Not significant
Hotness (App 14)	0.474	0.76	Not significant	0.247	1.37	Not significant
Odour (App 15)	0.099	2.50	Not significant	0.582	0.84	Not significant
Meatiness (App 16)	0.708	0.35	Not significant	0.899	0.44	Not significant
Appearance						
Colour (App 17)	0.000	26.78	Significantly different	0.123	1.74	Not significant
Outer Appearance (App 18)	0.000	13.23	Significantly different	0.391	1.10	Not significant

According to the results, assessors were able to discriminate the texture differences correctly. In order to change the texture, the fat levels of the products were changed. By this the tenderness, juiciness and rubberiness of the sausages were changed. As targeted at the training session the results proved that the assessors has recognized the definitions clearly and followed the procedure correctly to identify the flavour attributes. (App 2)

When considering the flavour attributes the results shows that, there is no significant difference between different salt and spice levels. This may due to several reasons. Five

different sausage samples were tested at the same time. So the result of one sample may affect to the other. The score given to one attribute can influence the score given to a different attribute. Sensory fatigue and adaptation can be happened.

The other thing is two attributes were tested using the same sample. For instance different salt levels and spice levels were tested using the same sample. So the high salt level may hide the effect of the high spice level in the same sample. The presentation of one sample with higher stimulus intensity than the other samples and can compress the range between them. This is called contrast effect. When the assessor assess high salt, high spice sausage sample he may feel the next sample as very low salt and spice than the true level.

Another thing is the effect of the presence of one substance can increase or decrease the perceived intensity of a second substance. For instance high fat sample can affect to the other flavour attributes. These are called enhancement or suppression effects.

The most important thing is the responses of assessors for a given attribute are not significantly different between assessors. This was true for all the sensory attributes. So even though some flavour attributes were not discriminated correctly, as a whole the uniformity between the assessors showed a great success.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATION

5.1 Conclusion

- The panel developed for sensory evaluation of meat products can be used effectively for that purpose.
- The panel has a sufficient knowledge and ability for descriptive sensory analysis of sausage products.
- Developed procedure of screening and training the panel and step by step sensory evaluation can be effectively applied.
- An easy to use score sheet, a time table and a procedure for daily sensory evaluation were developed.

5.2 Recommendation

- A programme for motivation of assessors must be developed. The assessors must be encouraged to participate for daily sensory analysis by giving them better recognition.
- Continuous assessment of panellists is a must. By that weaknesses can be recognized and can plan training to get them to the required level.
- The training programme must be extended to meat products other than the sausage range products.
- A flavour profile must be developed for sausage range products.
- A procedure must be developed for statistically analysis of sensory data at least monthly basis.
- The room for the sensory analysis must be modified. The preparation area must be separated from the sensory evaluation area. The booths must be well separated each other with better space for working area. The sensory area must not be used other than that purpose.

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Savic I.V, (1985) Small-scale sausage production, Food and Agriculture organization of the united nations [Access from: http://www.fao.org/docrep/003/x6556e/X6556E00.htm]

Reference-SLS Standards:

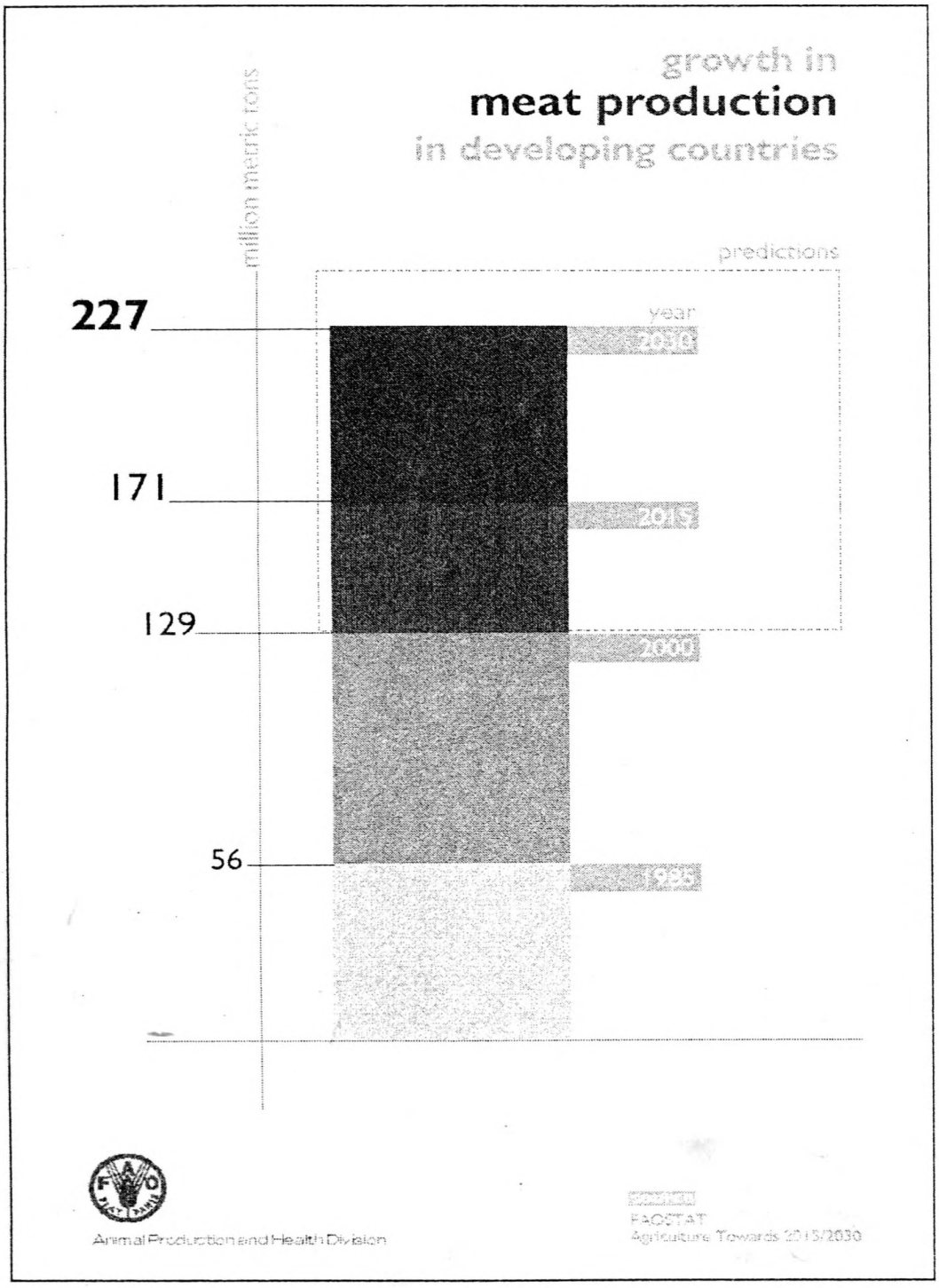
SLS 1218:2001	Sri Lanka standard Specification for comminuted meat products

Reference-ISO Standards:

ISO 8586-1:1993	Sensory Analysis- General Guidance for the selection, Training & Monitoring of assessors-Selected assessors-Part 1
ISO 8586-2	sensory analysis- general guidance for the select, training & monitoring of assessors, part 2, experts
ISO 8586-1:1993	Sensory Analysis- General Guidance for the selection, Training & Monitoring of assessors-Selected assessors-Part 1
ISO 6564	Sensory analysis –Methodology- Flavour profile methods.
ISO 11036: 1994	Sensory analysis-methodology-Texture profile
ISO 8589:1988	Sensory analysis- general guidance for the design of test rooms.

Appendix 01

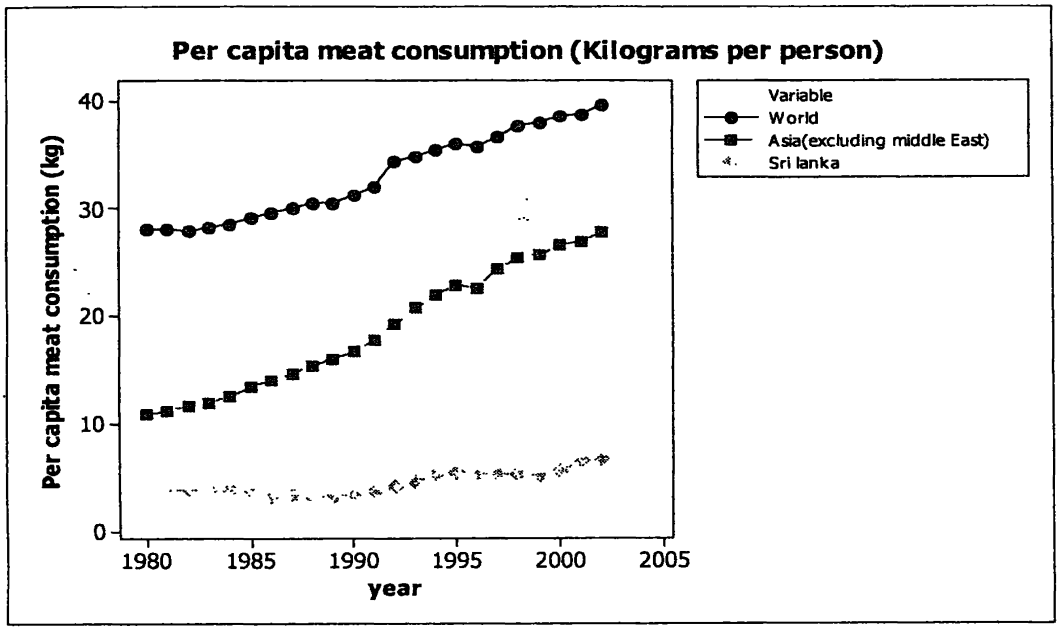
Growth in meat production in developing countries:



Source: (FAOSTAT, Agriculture towards 2015/2030)

Appendix 02

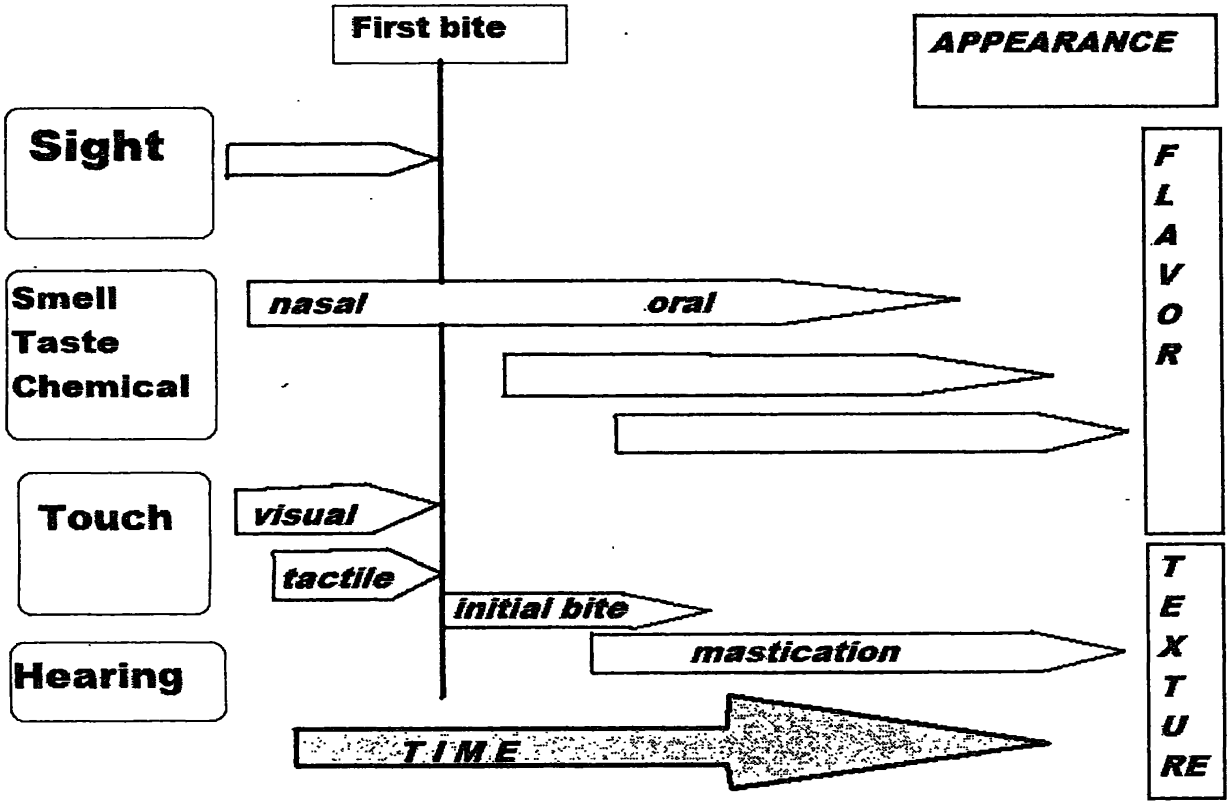
Per capita meat consumption in world, Asia and Sri Lanka



Source: (FAOSTAT, Agriculture)

Appendix 3

Representation of the Time Order of the Different Sensory Modalities.



Source: David kileast, 1999

Appendix 4:

Questionnaire for the recruitment of panellists

Sensory evaluation pre-screening test 2007

To check your interest and eligibility to work as a sensory assessor, please complete this questionnaire. All information will be kept confidential.

Name:.....Tel Ext:.....

Department:.....Date:.....

Designation:.....Sex(M/F):.....

Civil status(Married/Single):.....

1) Please indicate which of any of the following foods disagrees with you (Allergies, Discomfort, and Religious etc.)
   - Pork..... Chicken.....
   - Beef..... Lamb.....
   - Mutton..... Fish (specify).....
   - Soy..... Spices.....
   - Vegetables..... Other (specify).....

2) Please indicate if you are on a special diet.
   - Diabetic..... Low salt.....
   - High calorie..... Low calorie.....
   - Other(specify).....

3) Do you think developing a sensory panel is important? (yes / No)
4) Are you interested to be a sensory assessor? (Yes / No)
5) Do you have previous experience on sensory evaluation? (Yes/ No)
6) Please indicate the days and time you can allocate to participate for sensory evaluation.

Day	Time
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	

Thank you.....

Appendix 5:

Sensory analysis screening test 2007

Name:
Date:
Test:

You are given coded samples of 4 different meat types. Identify the meat types and write the name in front of the relevant code.

.....	.....	.....	.....
685	395	268	486

.....
Signature.

Appendix 06

Triangle test

Name:
Date:
Product type:

You are provided three coded samples. Two of them are same in all attributes (flavor, color, texture, juiciness) and one is different. Stating from left evaluate the samples and circle code that is different from other two. You may reevaluate the samples. You must make a choice.

547 795 384

.....

Signature.

Appendix 07

Steps of sensory analysis of comminuted meat products

1. **Apperance**
2. **Texture**
3. **Flavor**

Please practice the following order of sensory evaluation.....

1. **Outer Appearance: Major attributes**
    - Shape and Size
    - Shininess
    - Evenly smoked
    - Color – Shiny golden color

2. **Texture:**

Step 1. Slicing- Technique: Cut and evaluate a cross section.

Attributes

1. Coarse or fine texture – (coarse small gaps)
2. Rubberiness, hard or tender, Juiciness

Step 2 .First bite-Technique: One bite through with incisors.

Concentrating on,

- Force to server: The force required to partially bite through the product and tear using the incisors.
  This can use to get an idea about tenderness.

Step 3.First chew-Technique: One chew bite through evenly with molars.

Concentrating on,

- Force to compress- Measure the force required to fully compress the product with molars. Scales goes from easy to compress to difficult to compress.
  This can use to get an idea about tenderness.

Step 4. Chew down: Chew to bolus.

Attributes: a) **Juiciness-**

1. Impression of wetness during the first few chews and produces by rapid release of meat fluid.
2. Sustained juiciness, largely due to the stimulatory effect of fat on salivation.

b) Tenderness-

c) Rubberiness-

- Number of chews to bolus: Count actual number of chews necessary to form a wad.
  - Low fat ☐
  - Standard ☐
  - High fat ☐
- Rubberiness: Measure amount of resistance felt against the molars during chew down. Scale goes from not any resistance to lots of resistance.
- Moisture of mass: Measure the amount of moistness/ oiliness of mass at bolus. Scale goes from dry mass to moist mass.

3.**Flavour-** Taste + Odour = Flavour

- How to smell? Three deep, quick sniffs and then odour source is removed.
  Gap = 20 seconds between two samples.
- How to taste? Wash the pallet between two samples and eat cream cracker to neutralize the taste buds.
- After taste- Spiciness and hotness can be detected.

4. **Overall acceptability-** Decide it by considering above all factors

Appendix 08

Sensory evaluation check list

Please rank your preferences according to the scale given below. (Please try to evaluate using the given order of the leaflet)

5- Too much above the expected level

4- A little above the expected level

3- Just right to the expected level

2-A little below the expected level

1-Too much below the expected level

Please compare the samples with the reference sample and fill the check list. (Reference sample =3)

Sample	Appearance			Texture			Overall texture	Flavour					Overall taste	Overall acceptability	Remarks/ improvements
	outer	inner	color	Tenderness	Juiciness	Rubberiness		Meat	Spices	Hotness	Salt	Odour			

Name:.....

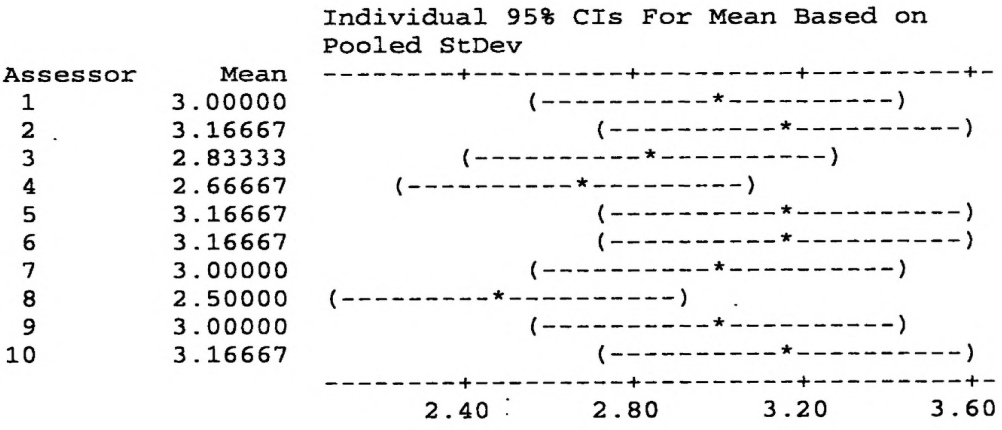
Signature:.....

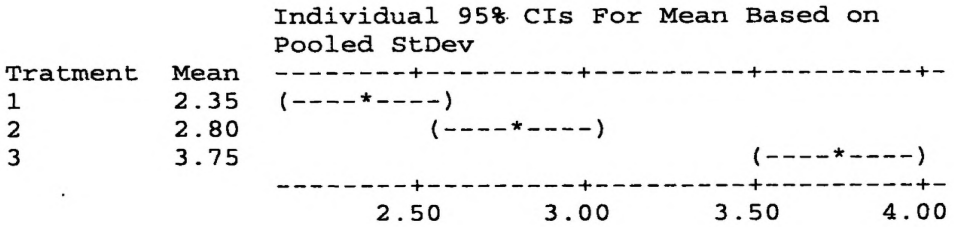
Appendix 9

Two-way ANOVA: Score versus Assessor, Treatment

Source	DF	SS	MS	F	P
Assessor	9	2.9333	0.3259	1.22	0.319
Treatment	2	20.4333	10.2167	38.31	0.000
Interaction	18	4.5667	0.2537	0.95	0.532
Error	30	8.0000	0.2667		
Total	59	35.9333			

S = 0.5164 R-Sq = 77.74% R-Sq(adj) = 56.22%





h0: There is no significant difference between three tenderness levels.
h1: Three tenderness levels are significantly different.

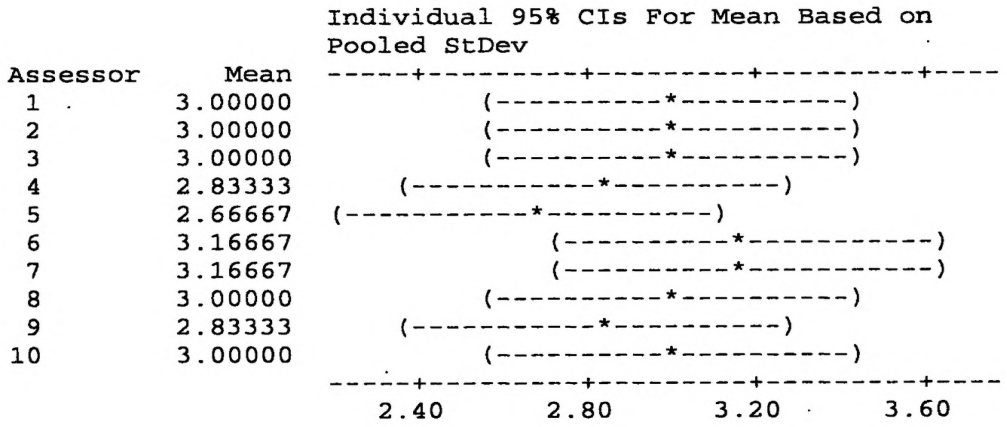
- P value of three treatments is below 0.05. So we can reject h0. So three treatments are significantly different.
- P value of ten assessors is over 0.05. So there is no significant difference with assessors. And there is no interaction effect.

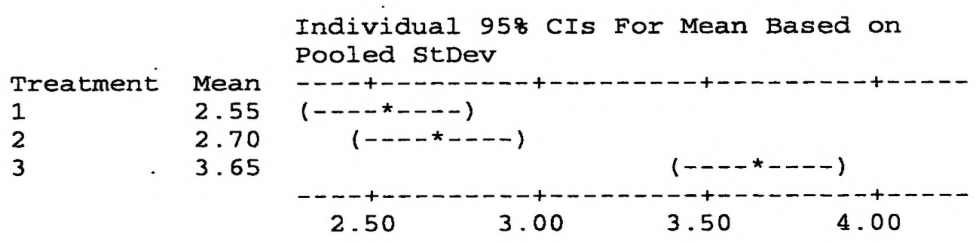
Appendix 10

Two-way ANOVA: Response versus Assessor, Treatment

Source	DF	SS	MS	F	P
Assessor	9	1.2667	0.14074	0.47	0.884
Treatment	2	14.2333	7.11667	23.72	0.000
Interaction	18	5.4333	0.30185	1.01	0.480
Error	30	9.0000	0.30000		
Total	59	29.9333			

S = 0.5477 R-Sq = 69.93% R-Sq(adj) = 40.87%





h0: Treatments are not significantly different
h1: Treatments are significantly different

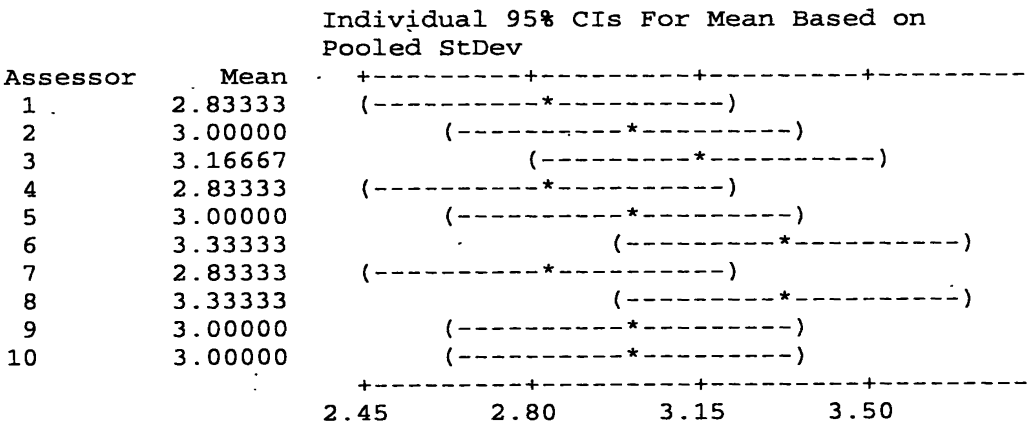
- P value for treatments is below 0.05. So treatments are significantly different. so assessors were able to identify the three juiciness levels.
- P value for ten assessors is higher than 0.05. So there responses are not significantly different with each others.

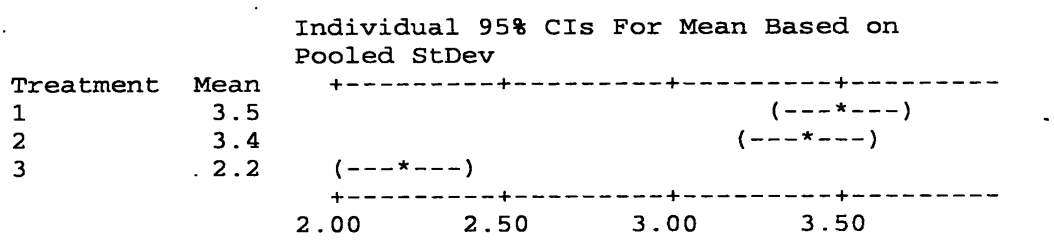
Appendix 11

Two-way ANOVA: Score versus Assessor, Treatment

Source	DF	SS	MS	F	P
Assessor	9	1.9333	0.2148	1.07	0.409
Treatment	2	20.9333	10.4667	52.33	0.000
Interaction	18	5.0667	0.2815	1.41	0.199
Error	30	6.0000	0.2000		
Total	59	33.9333			

S = 0.4472 R-Sq = 82.32% R-Sq(adj) = 65.23%





h0: Treatments are not significantly different
h1: Treatments are significantly different

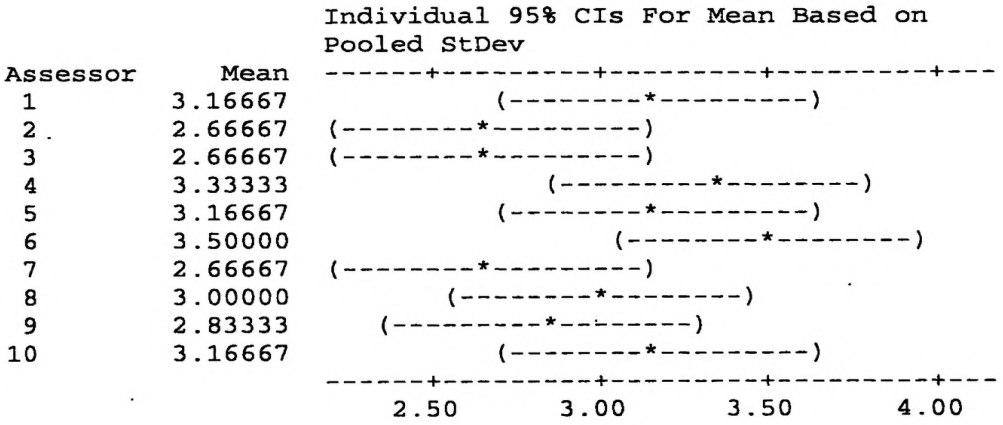
- P value for three treatments is below 0.05. So treatments are significantly different.
- p value for ten assessors are higher than 0.05. So responses between assessors are not significantly different.

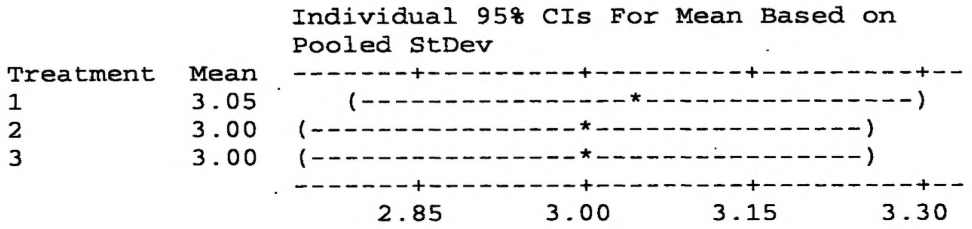
Appendix 12

Two-way ANOVA: Score versus Assessor, Treatment

Source	DF	SS	MS	F	P
Assessor	9	4.8167	0.535185	1.69	0.135
Treatment	2	0.0333	0.016667	0.05	0.949
Interaction	18	4.6333	0.257407	0.81	0.672
Error	30	9.5000	0.316667		
Total	59	18.9833			

S = 0.5627 R-Sq = 49.96% R-Sq(adj) = 1.58%





h0: Treatments are not significantly different
h1: Treatments are significantly different

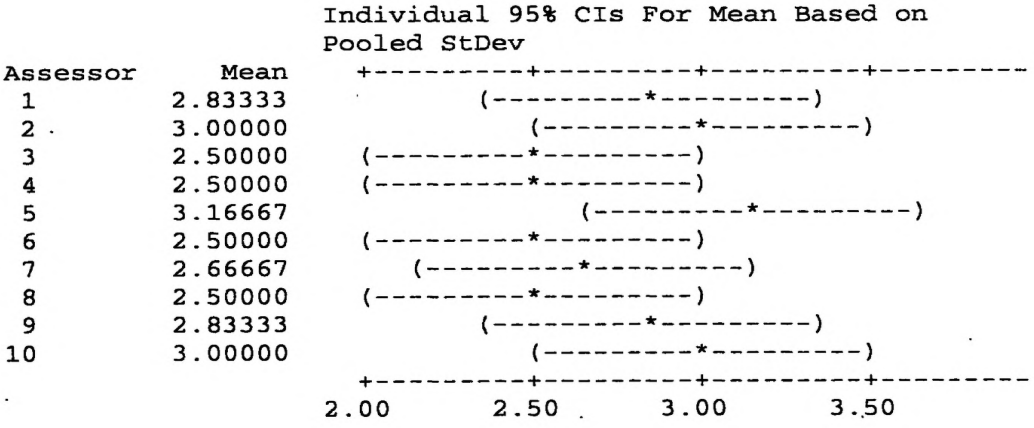
- Treatment p value is higher than 0.05. So treatments are not significantly different.

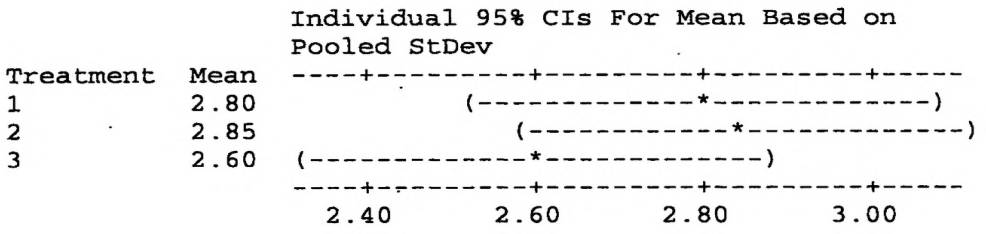
Appendix 13

Two-way ANOVA: Score versus Assessor, Treatment

Source	DF	SS	MS	F	P
Assessor	9	3.4167	0.379630	1.08	0.402
Treatment	2	0.7000	0.350000	1.00	0.380
Interaction	18	6.6333	0.368519	1.05	0.438
Error	30	10.5000	0.350000		
Total	59	21.2500			

S = 0.5916 R-Sq = 50.59% R-Sq(adj) = 2.82%





h0: Treatments are not significantly different
h1: Treatments are significantly different

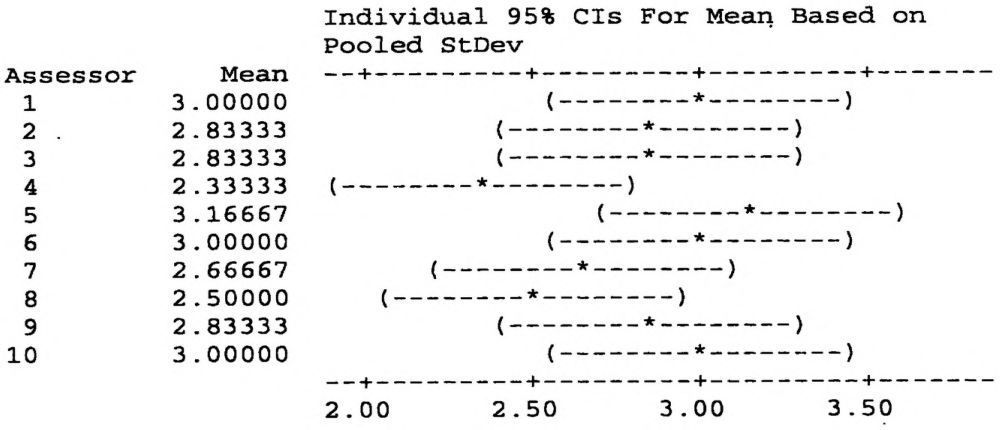
- P value for three treatments are higher than 0.05. So treatments are not significantly different.

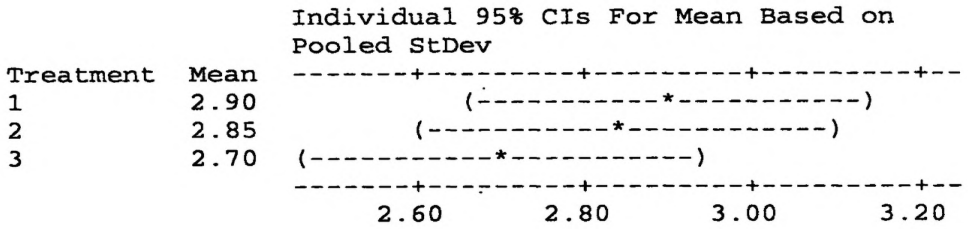
Appendix 14

Two-way ANOVA: Score versus Assessor, Treatment

Source	DF	SS	MS	F	P
Assessor	9	3.4833	0.387037	1.37	0.247
Treatment	2	0.4333	0.216667	0.76	0.474
Interaction	18	6.5667	0.364815	1.29	0.263
Error	30	8.5000	0.283333		
Total	59	18.9833			

S = 0.5323 R-Sq = 55.22% R-Sq(adj) = 11.94%





h0: Treatments are not significantly different
h1: Treatments are significantly different

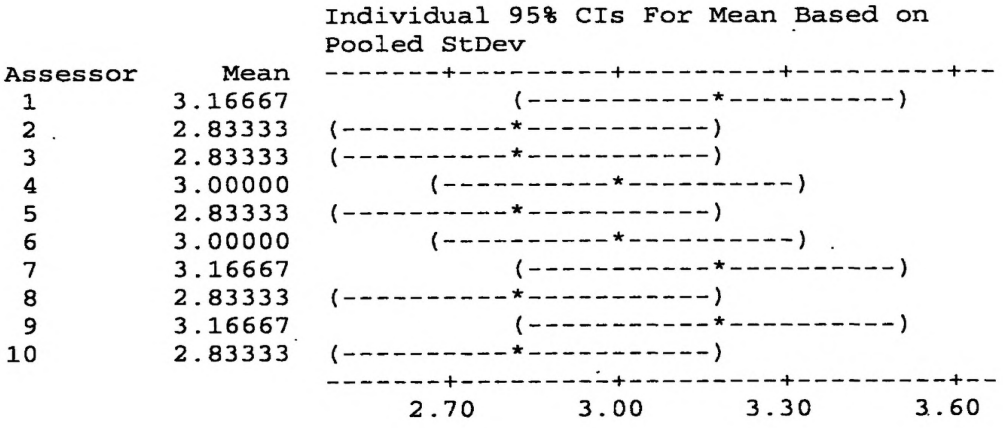
- P value for three treatments are higher than 0.05. So treatments are not significantly different.

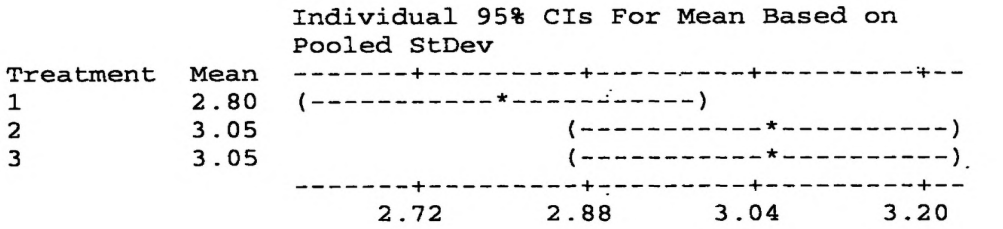
Appendix 15

Two-way ANOVA: score versus Assessor, Treatment

Source	DF	SS	MS	F	P
Assessor	9	1.26667	0.140741	0.84	0.582
Treatment	2	0.83333	0.416667	2.50	0.099
Interaction	18	2.83333	0.157407	0.94	0.539
Error	30	5.00000	0.166667		
Total	59	9.93333			

S = 0.4082 R-Sq = 49.66% R-Sq(adj) = 1.01%



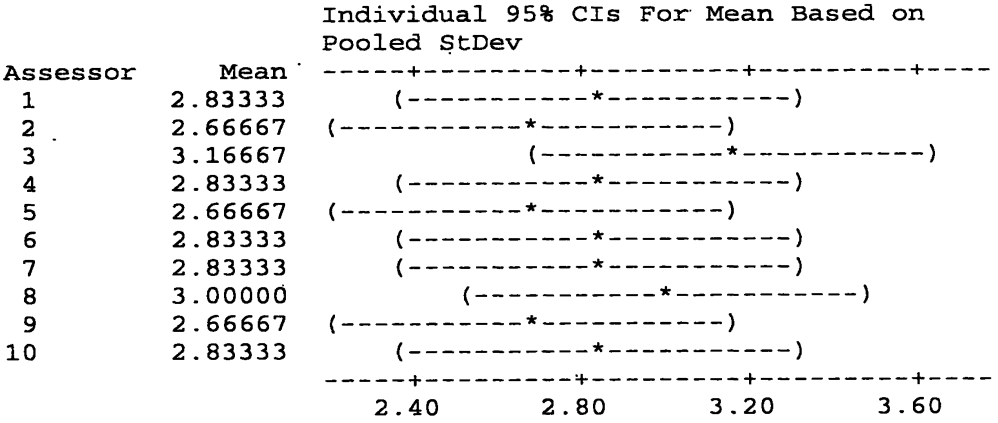


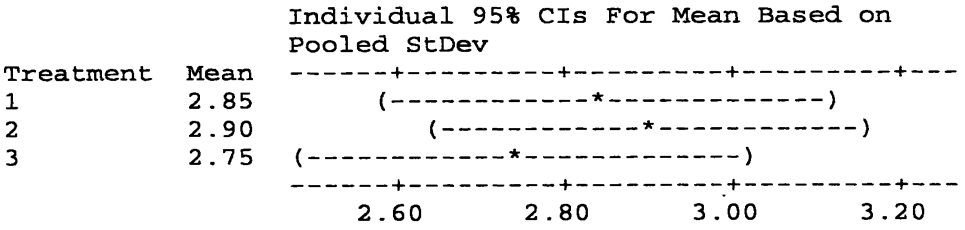
Appendix 16

Two-way ANOVA: Score versus Assessor, Treatment

Source	DF	SS	MS	F	P
Assessor	9	1.3333	0.148148	0.44	0.899
Treatment	2	0.2333	0.116667	0.35	0.708
Interaction	18	2.7667	0.153704	0.46	0.956
Error	30	10.0000	0.333333		
Total	59	14.3333			

S = 0.5774 R-Sq = 30.23% R-Sq(adj) = 0.00%





h0: Treatments are not significantly different
h1: Treatments are significantly different.

P value for treatments is higher than 0.05. so treatments are not significantly different.

P value for assessors is also higher than 0.05. so assessors response also not significantly different.

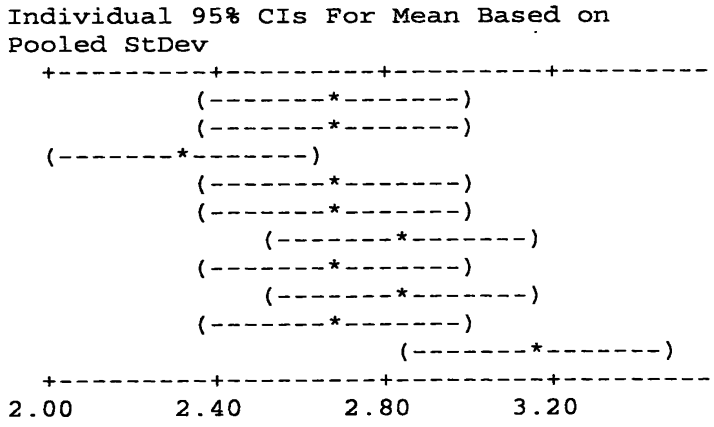
Appendix 17

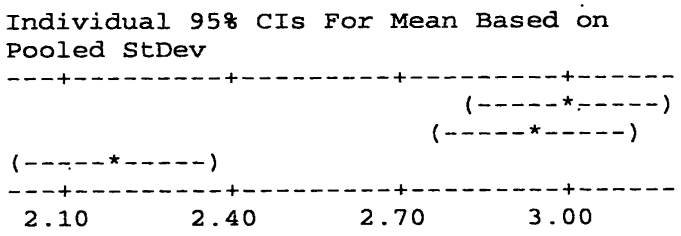
```
Welcome to Minitab, press F1 for help.
```

Two-way ANOVA: Score versus Assessor, Treatment

Source	DF	SS	MS	F	P
Assessor	9	2.3500	0.26111	1.74	0.123
Treatment	2	8.0333	4.01667	26.78	0.000
Interaction	18	3.3000	0.18333	1.22	0.305
Error	30	4.5000	0.15000		
Total	59	18.1833			

S = 0.3873 R-Sq = 75.25% R-Sq(adj) = 51.33%





h0: Treatments are not significantly different
h1: Treatments are significantly different

- P value for treatments is below 0.05. So treatments are significantly different.

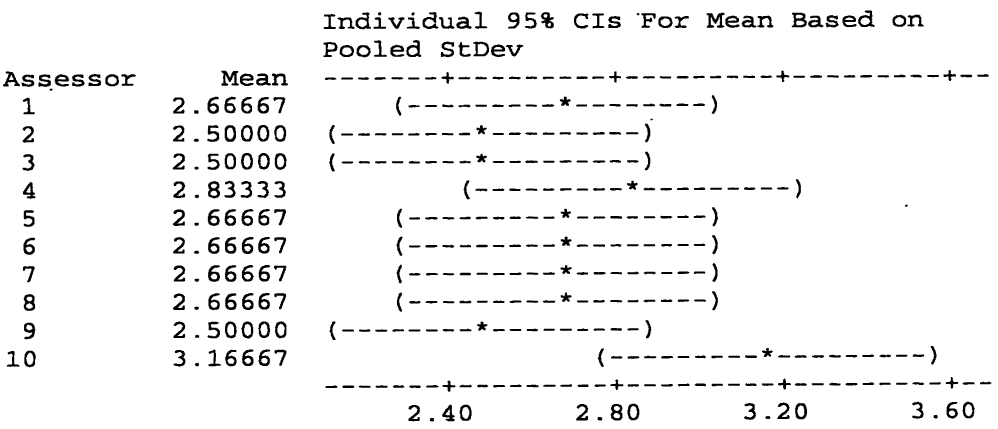
Appendix 18

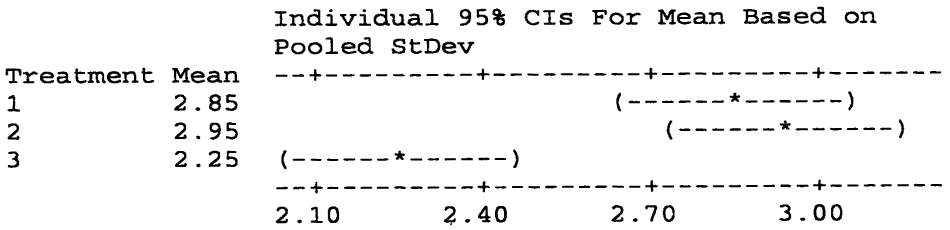
```
Welcome to Minitab, press F1 for help.
```

Two-way ANOVA: Score versus Assessor, Treatment

Source	DF	SS	MS	F	P
Assessor	9	2.1500	0.23889	1.10	0.391
Treatment	2	5.7333	2.86667	13.23	0.000
Interaction	18	2.6000	0.14444	0.67	0.815
Error	30	6.5000	0.21667		
Total	59	16.9833			

S = 0.4655 R-Sq = 61.73% R-Sq(adj) = 24.73%





h0: Treatments are not significantly different
h1: Treatments are significantly different

- P value for treatments is below 0.05. So treatments are significantly different.

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