DEVELOPMENT OF KURAKKAN (FINGER MILLET) NOODLES

By

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Thesis submitted in partial fulfillment of the requirement of the Degree of Bachelor of Science in Food Science and Technology of the Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Buttala, Sri Lanka.

January 2002

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AFFECTIONALLY DEDICATED TO
MY EVERLOVING PARENTS
AND TEACHERS

ACKNOWLEDGMENT

First of all I would like to express my heartfelt thank to Dr. K.K.D.S Ranaweera, the Dean faculty of Applied Sciences Sabaragamuwa University of Sri Lanka for directing and leading for a successful study and his intelligerit guidance through out my study.

I wish to express my deepest gratitude to my internal supervisor Mrs. Indira Wickramasinghe lecturer, Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka for her valuable advice, encouragement and guidance to this study and reading the manuscript and sparing her valuable time in bring this study to a success completion.

Also I extend My deepest gratitude to my external supervisor Mr.K.K.Kithsiri, the Managing Director of Mister Hop Food (Pvt.) Ltd., Wataraka, Padukka.for his excellent guidance, encouragement, advice and supervision through out my study.

I wish to express my gratitude to Mr. Samansiri, Production Manager Mister Hop Food Lanka (Pvt.) Ltd. Mr. Viraj Jonikkuhewa and other staff members of Mister Hop Food Lanka (Pvt.) Ltd. providing me the raw material and essential equipment and their numbers help and also thanks to Mr.Udaya Kumara, SGS Lanka (Pvt.) Ltd.

Finally my heartfelt thanks are extended to Miss. L.M.N Sigera and all staff members Faculty of Applied Sciences, buttala, Also my thanks are extended to My parents, sister, batch mates and to my colleagues especially Mr. Ananda Jayaweera, Miss U.Wijewardana for helping me in numbers of ways to make this study successful.

ABSTRACT

Kurakkan noodles is available in the market in different types. But most of the **kurakkan** noodles are not fulfilling consumer requirements due to lack of **kurakkan** flavor and palatability in these products. These available **kurakkan** noodles do not address the consumer requirements. **kurakkan** noodles has developed not only the palatability of food but also the health aspects.

Here in this study to increase the **kurakkan** percentage in noodles I have prepared four types of **kurakkan** noodles with varying **kurakkan** percentages. The incorporated **kurakkan** percentages were 20%, 30%, 45%and 60%. When preparing the noodles I incorporated rice and wheat flour to get the exact structure of **kurakkan** noodles and also to get the strength of noodles.

Then selected the best sample (524) by sensory evaluation using 19 judges. Statistical analyses were done by using the ranking method. After that I had carried out the sensory evaluation with the selected best **kurakkan** noodles and with two market leaders in order to find out consumer acceptability and about the improvement of quality in my prepared best sample. Here too the ranking method was used.

Also the composition of the best sample was analysed and compared with the Sri Lanka standards, to assure the quality requirements of the made product.

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CHAPTER 1

1.1 Introduction

In the present situation demand for various types of food is very high in the world and the some in our country too. So we should improve our food production and technology to reach this target. When increasing the food harvest as an ingredient, in the food production industry in order to promote our locally available resources. Now a days noodle is one type of food item popular among our Sri Lanka housewives. Noodles represent a dominant usage of wheat flour in most part of Asia. Many Asian countries, including China, are rapidly growing as wheat importers. Food scientists are interested in developing new, high–quality, convenient forms of noodles often developed from traditional formulation and processing methods.

Sri Lanka is a developing country. Our country has many nutrition problems. So we should increase our food production using mainly local food crops. **Kurakkan** (finger millet) is cultivating in Sri Lanka. But availability is very low. Traditionally it's used to make **rote**, **talapae,** and **halapae** etc.

Kurakkan is a highly valued nutrition food item. It has low fat content, high fiber, calcium and iron . So it is use as a health food. We should increase the availability of **kurakkan** as food science students. Although **kurakkan** noodles are available in the market ,but poor in quality. In this study I have tried to increase the quality of **kurakkan** noodles and to find maximum level of the **kurakkan** to incorporate to obtain a better quality consumer accepted product A noodle is one type of pasta. Pasta is the genetic term for such food as noodles instant. macaroni, spagehetti and for vermicelli made from wheat flour and water with or without other optional ingredients then shaped through plates or extruded through an extrusion press fitted with a die of the desired size, partially dried in hot air, then completely dried and move slowly at a lower temperature.

Noodles is a product made from a dough prepared from wheat with or without other optional ingredients, kneaded, extruded through on extrusion press fitted with a die of the desired size or pressed through sheeting rolls and out into the desired length either dried or pre-cooked in steam and dried.(Sri Lanka standard 420:1989)

In mostly making of noodles is by taking sheet and cut into desire length, to that process there is a effect from gluten. **kurakkan noodles** gluten percentage is very low so we can't predict about the exact gluten activity. Starch percentage is high in **kurakkan.** So gelatinization

of starch is used for the making of noodles. And strand making is done by extruder machine. So we can obtain a good length in noodles.

1.2 Objectives

1. Making of good quality noodles.

2. Finding of the maximum level of **kurakkan** to be incorporated into noodles.

CHAPTER 2

Literature view

2.1Definition of Noodles

A product made from a dough prepared from wheat flour and water with or without other optional ingredients, kneaded, extruded though an extrusion press fitted with die of the desired size or passed through sheeting rolls and cut into the desired length either dried pre- cooked in steam and dried.(Sri Lanka Standard 420:1989)

2.2 History and Origin of Noodles

Noodles are strips or strands cut from a sheet of dough made of flour, water and either common salt or a mixture of alkaline salts. They are one of the main staple foods consumed in east and southeast Asian countries; representing up to 40% of total flour consumption (miskelly, 1988). It is believed that noodles originated in the north of China as early as 5000 B.C. but their essential modern –day form has developed over the last 2000 years. Present day noodles were a unique contribution by the Han Dynasty (206B.C.to 220A.D.) To Chinese culinary art. The development of noodle foods in the Han period seemingly can be explained by the fact that techniques for large-scale flour milling were introduced to china from the west during the latter part of the earlier Han Dynasty, as a result of the Han expansion.Han ingenuity in experimenting with such common food materials, combined with the willingness to incorporate technology from other cultures, led to emergence of an eventually dominant new product in Chinese culinary history (yu, 1979). The writer Shu His in the western Jin Dynasty (late third and early forth centuries) The art of noodle making developed further in the Tang Dynasty (618-907A.D.). when the noodles were first cut into long strips. The age –old custom of eating noodles to signify long life is believed to have originated in this era. During The period of the Song Dynasty (960-1179A.D.) the variety of different styles of noodles gradually increased as unique local tastes were developed, and a great variety of into being (Wand, 1987) .The technique of making dried noodles was learned in the yuan Dynasty (1271-1368A.D.) and in the Ming Dynasty (1368-1644A.D.) noodles were given the name of main and since then, have continued to evolve until the present (Huang, 1996). With increased travel and trade and widespread Chinese migration and emigration, noodles were taken across the country as China to Korea, Japan, Thailand, Malaysia, Indonesia, Singapore, the Philippines, Burma, and Vietnam with the many Chinese

traders, seafarers and emigrant who moved into these areas. The similarities of some of the genetic words for noodles mi(China0, men (Japan),mee(Thailand),In Japan ,undo noodles were created in the 15th century. And most of the types of noodles found today were available by the 16th century. (Nagao, 1979;1981).

2.3 Classification of Noodles

There are regional for noodle color, texture, flavor size and shape, shelf life and ease of cooking, which in turn depend on the flour characteristic, method of preparation and the inclusion of other raw material or chemical additives. The terminology of classifying noodles can be confusing since noodles of almost identical composition have different names in various countries. Moreover, within the same country, noodles of the same formulation are sometime named to differentiate the manufacturing process and the noodle strand thickness (Dick and matsuo, 1988). Noodles are commonly classified according to,

1. The size of the noodle strands.
2. The nature of the raw material used in their manufacture.
3. The method of the preparation and
4. The form of the product on the market (Crosbic et al., 1990).

2.3.1.Classification by the Size of Noodles

Noodles vary widely in the size of the noodle strands. In Japan the main types classified according to width include very thin noodles (so-men), thin noodles (Hiya-mugi) standard noodles (udon) and flat noodles (Hira-men).

Table 2.1: -Classification of Japanese Noodles

Class	strand width	cutting rolls	dried or boiled
So-men(very thin)	1.0- 1.2	30- 26	dried
Hiya-mugi(thin)	1.3- 1.7	24- 18	dried
udon(standard)	2.0- 3.8	16-8	Dried or boiled
Hira-men	5.0-7.5	6-4	Dried or boiled

Source: Pasta product and technology (1997).

2.3.2.Raw material

According to the raw material we can observe mainly three types of noodles

*Japanese noodles (udon)

*Chinese type noodles (ra-men)

* Buckwheat noodles (soba)

2.3.2.1.Japanese Noodles

Japanese noodles are white or creamy white in color and soft in texture. They are the product of soft wheat flour of medium protein content and made from a mixture of flour (100parts) water (28-45parts) and salt (2-3parts)

2.3.2.2.Chinese Type Noodles

Ra-men noodles are light yellow in color and a little stiff in texture. They are the product of hard wheat flour, and made from a mixture of flour (100parts) water (32-35parts) and kansun (a mixture of alkaline salts- about 1 part)

2.3.2.3.Buckwheat Noodles (soba)

These are light brown or gray in color with a unique taste and flavor. They are made from a mixture of buckwheat flour, wheat flour and water. The ratio of wheat flour to buckwheat flour varies according to the type of product.

2.3.3.Classification by the Method of Manufacturing

In the manufacture of most noodles, dough will be sheeted and cut into strands of desired width. Most of them are made by machine with similar methods of mixing, sheeting, combining of two sheets, rolling and cutting, but two types of handmade noodles available. In the manufacture of very thin handmade noodles soft dough made into strands are twisted and stretched out repeatedly into the final product. This technology can be applied to thin noodles. And standard noodles (udon) noodles made by this method are quite favorable in texture. Handmade standard or flat noodles are products made by hand through the processes of mixing. Sheeting and cutting.

Table 2.2: -Classification of Japanese Noodles by manufacturing method

Class	strand width(mm)	manufacturing method
So-men(very thin)	1.0 -1.2	handmade or machine made
Hiya-mugi(thin)	1.3-1.7	handmade or machine made
Udon(standard)	2.0-3.8	handmade or machine made
Hira-men(flat)	5.0-7.5	handmade or machine made

Source: Pasta product and technology (1997).

2.3.4.Available forms of Noodles in the market.

2.3.4.1Uncooked Wet Noodle

The most popular from of Chinese type noodles sold to retail shop and restaurant is fresh and uncooked.

2.3.4.2.Dried Noodles

Kan-men is the genetic term for dried so-men hiya-mugi, undo, hira-men and soba. It's one of the most popular forms of Japanese noodles and does the controlled drying of uncooked wet noodle strands produce a storable form.

2.3.4.3.Boiled Noodles

This is the most popular marketing form of udon. It's old unpacked simply packed or completely packed. Due to the packing condition, shelf life of the products varies.

2.3.4.4.Steamed Noodles

These are steamed instead of boiled.

2.3.4.5.Instant Noodles

Noodle strands gelatinized in a steamer are dried by frying or by hot blast drying, the products of which are classified into fried instant noodles and non – fried instant noodles.

2.3.4.6.Frozen Boiled Noodles

This is made by the rapid freezing of noodles immediately after boiling.

2.4.Ingredients

In making of noodles we use flour, water, and salt. The ingredients used should be clean, whole some and free from evidence of inert and rodent infestation.

2.4.1.Flour

Flour is the main ingredient of making of noodles. Several types of flour are use for the production of noodles.

*Wheat flours

*Kurakkan flour

*Rice flour

2.4.1.1Wheat

Wheat flour is the ingredient that, more than any other will influence the processing. Response of most dough as batters determines the finished quality of most bakery products.

Wheat gluten and wheat starch are economically important coproducts produced during the processing of wheat flour. Wheat gluten is a commodity food ingredient and its application is predominantly in baked goods, breakfast goods cereal, pet foods and processed meat products. The specially wheat production are finding are increasing uses in nontraditional gluten markets as calf milk replaces, cosmetics egg white replaces, pasta, biscuits, dairy products, and vegetarian foods.

2.4.1.2.History of wheat grain

It is generally agreed that wheat was one of the first cereal grains to be cultivated. According to their tradition, the Chinese were growing wheat a long ago as 2700B.C. It has been cultivated around the eastern Mediterranean and in Mesopotamia for at least 5,000-6,000.There is abundant evidence that the ancient civilization of Babylon, Egypt, Crete, Greece, and ROM were dependent upon wheat as a principal food. Today large quantities of wheat are produced in Europe Pakistan, India, china, south and North America, Australia and several other countries some of the best quality whet is grown in Canada. Altogether about 600 million tones of wheat are produced around the world.

2.4.1.3.Types of Wheat

Which the following are the main groups of wheat.

Table 2.3

Aestivam (vulgare)	– Common
Wheat Durum	_ Durum wheat
Compactum	_ culb wheat
Turigidum	_ Poulard
Wheat Dicoccum	_ Emmer
Wheat Spelta	_ Spelt
Wheat Polonicum	_ Polish

wheat For commocial purposes wheat is generally classified as hard or soft, red or white spring or winter so that for example we refer to wheat as being a "hard red winter wheat" .

2.4.1.4.Composition of wheat (ranges)

Table2.4

Determination	Low	High
Protein	7.0	18.0
Mineral	1.5	2.0
Starch	60.0	68.0
Cellulose(crude fiber)	2.0	2.5
Moisture	8.0	18.0
Lipid	1.5	2.0

Data assembled from several sources

2.4.1.5.Gelitinisation of starch in hot water

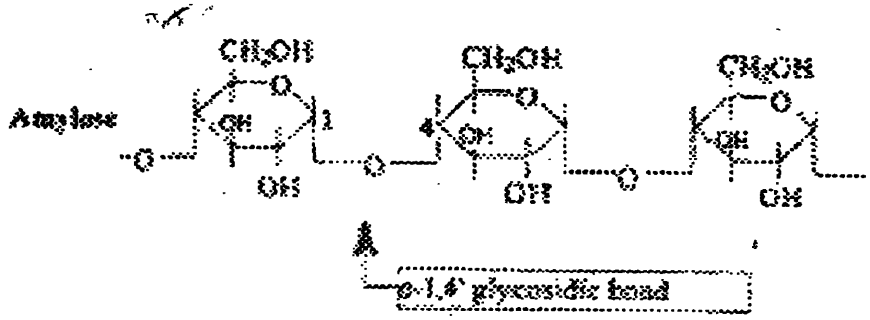
Starch granules take up more water irreversibly and swell, some short chains of amylose come out of the granules. This process called gelatinization.

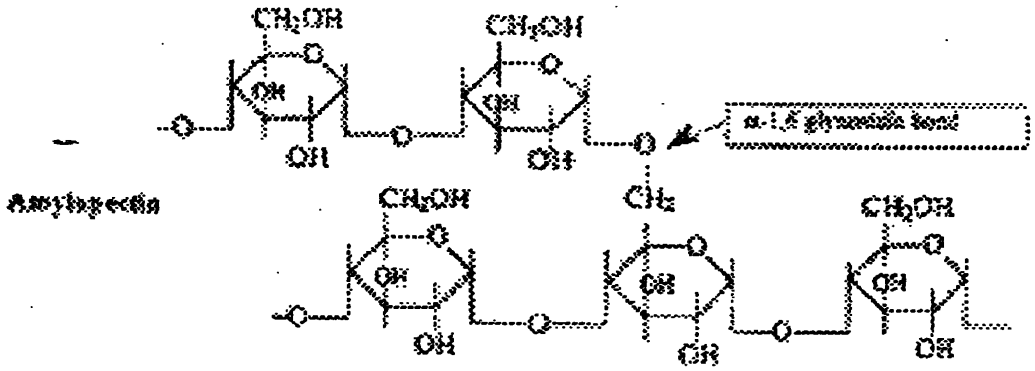
One of the most important properties of starch is its ability to form gels (or pastes) on heating with water .The degree of gelatinization depends of sugar protein fats organic acids, as are commonly found in foods. Govern the temperature at which gelatinization on the temperature and this varies from one type of starch to another. Other factors, such as the presence occurs. The higher content of phosphate in amylopectin is a factor in this component. Being largely responsible for the starch pasting viscosity. Naturally, the viscosity of the starch will vary with the concentrate the type of starch used.

The swelling of the granules on heating in water and the formation of a gel (or paste) are most conveniently followed using a hot stage microscope. The gelatinization temperature is varying one type to other types. Below show the gelatinization temperatures for a number of common starches.

Gelatinization temp: (0C)

Wheat 53-64





Rice 65-73

Kurakkan 64-68

The amylopectin is extremely important in the process of gelatinization (test and morris on 1990b) starch swelling at temperatures greater than about 70°C is related to the amylopectin molecule.

Fig2.1Parts of the structure of amylose and amylopectine, shown in Haworth representation.

2.4.2.Finger millet

Millet are small grained cereals, the smallest of them include finger, kado, fixtail, proso little and barnyard millets. They are the staple food of the million of people inhabiting the arid and semiarid tropics of the world thy are distributed in most of the Asian and African countries and parts of Europe. The grains of small millets, being nutritionally superior to rice and wheat provide cheap proteins, minerals and vitamins to poorest of the poor where the need for such ingredient in the maximum.

2.4.2.1.Millet in Sri Lanka

Small millet grown in Sri Lanka is Eleusine coracana (finger millet), Panicum millaceum (common millet) and Setaria italica (foxtail millet) Area under finger millet ranges from 16,000 to 44,000 ha and the annual production from 7,000 to 18,000 tones. Area under common millet ranges from 900 to 2,500 ha and the production from 500 to 1,100 tones. foxtail millet has the lowest acreage among the millets and ranges from 24 to 425 ha and the production from 24 to 195 tones (table 2.5) finger millet is grown traditionally under the shifting forest fallow system (chena)in the dry zone.

2.4.2.2.Trends in millet production

Table 2.5

Years	Finger millet		common millet		Foxtail millet	
	area	production	area	production	area	production
	(ha)	(tones)	(ha)	(tones)	(ha)	(tones)
1975	43,836	17,873	2,501	489	425	173
1976	39,526	17,640	1,072	841	284	195
1982	16,035	13,300	-	-	-	-
1983	20,595	11,662	934	934	24	24
1984	16,489	6,570	-	-	-	-

Source: dept. of Agriculture, Sri Lanka (1984).

Important areas of finger millet production are Anuradhpura, and Hambantota districts in the dry zone. Matale, Monaragala districts in the intermediate zone and Ratnapura district in the wet zone.

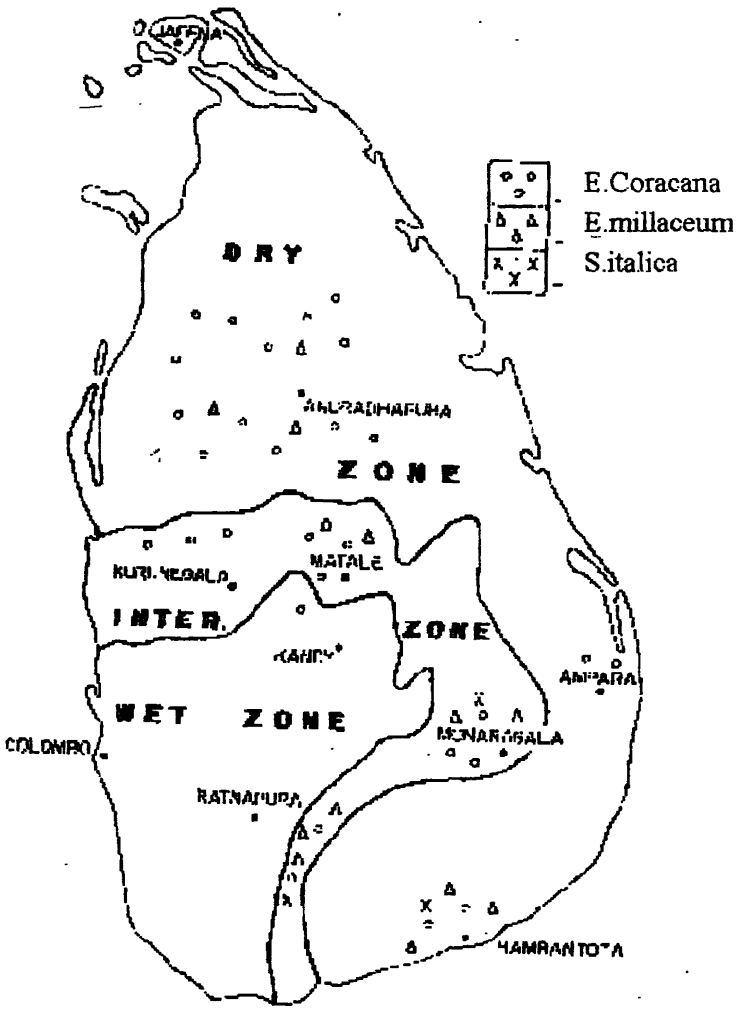


Figure 2.3
Important Area of Millet in Sri Lanka

Important areas of finger millet production and coverage in 1985 (ha)

Table 2.6

District	1985
Anuradhapura	7,600
Hambantota	1,165
Kurunagala	1,440
Monaragala	1,965

Source: dept. of agriculture, Sri Lanka (1985)

2.4.2.3.Composition

Finger millet has very good nutritional value when compared with other cereals. It's composition as follows.

Table 2.7 composition of finger millet

Protein	9.2%	Energy	336Kcal
Fat	1.29%	Ca	350mg
Carbohydrate	76.32%	Fe	3.9mg
Mineral	2.24%	Ash	3.90%
Dietary Fiber	18.9%	Thiamin	0.42mg
		Riboflavin	0.19mg
		Niacin	1.1mg

2.4.2.4.Utilization

Ragi is typically a tropical crop. It is the principal food grain of the agricultural classes in Musore, Madras, and Bombay in the hill tracts of Northern India And in Sri Lanka.it is usually converted into flour and variety of preparations as- cakes, pudding porridge etc. are made. A fermented drink or beer is prepared from the grain in some parts of Bombay and in the Himalaya tracts.

2.5.Rice

Rice (Oryza sativa L.) is one of the leading food crops of the world The staple food of over half the world 's population it is generally considered a semi aquatic annual, grass plant. Rice is the staple food of East, southeast, and south Asia, where 90% of the world's rice crop is produced and consumed

Rice actually is calculated to produce more food energy per hectare than the other cereals (eggum, 1969,1977,1979;FAO, 1982).

Total food protein production per hectare is also high rice, second only to that for wheat when the superior quality of rice protein is considered, the yield of utilizable protein is actually higher for rice than for wheat.

2.5.1.Composition

Starch, usually calculated as available carbohydrate is the major component of rice.Rice has the lowest protein content among the cereals and is also low in fiber.The cereal grain are relatively low in fat(lipid)content Iron and zinc availability is low.

Property	brown rice
Protein (N* 6.25)	7.3
Crude fat	1.9
Available Carbohydrate	64.3
Crude fiber	0.8
Crude ash	1.4
Thiamin	0.29
Riboflavin, Mg/100g	0.04
Niacin, mg/100g	4.0
Iron, mg/100g	3
Zinc, mg/100g	2
Energy, kJ/100g	1,610

Table 2.9

Data from eggum (1969, 1977,1979)wolff(1982).

2.5.2.Utilization of Rice

Milled raw and parboiled rice is consumed mainly as boiled rice. Various rices with specific amylose –amylopectin ratios are used in specific rice products and in various regions. waxy (glutinous) rice is the staple food in Laos and northern and northeastern Thailand and is

usually prepared by steaming milled rice previously soaked in water (Kongscree,1979). Waxy rice are used also in sweets, desserts ,and salad dressing .In the united states, low – amylase (12-20% amylose) rice are used in baby foods, breakfast cereals and yeast –leavened rice bread. Rice in temperate counties (Japan, Korea , the European Economic Community)and in Northern China are low amylase variety intermediate-amylose rice are used mainly for fermented rice cakes in the Philippines and in canned soup in the United States. High amylase (>25)rice are preferred for excluded rice noodles. Among high –amylose rice, soft gel consistency is preferred to hard gel consistency

Japanese rice are over milled to remove 20-50%by weight of brown rice and the residue is used manufacture sake, Japanese rice wine. Rice is main protein sources In the Sri Lanka.

2.6 Food Extrusion

Extrusion may be defined as forcing a pumpable product though a small opening to shape materials in a designed fashion. The extrusion process may occur through use of a piston, a set of rollers, or screw to force the material, usually through a narrow opening, into the desired shape. A home cookie maker is a simple example of an extruder. Cookie dough is forced through a specially shaped die, or opening, by use of a piston in a cylinder to form the desired shape of cookie.

Food extruders in processing plants work by the same principle, except that typically a screw device is used to pump the food material through a narrow die opening into the desired shape. In many food extrusion processes, heating and cooking of raw materials occur as they are mixed and formed to produce essentially finished product in a single operation.

2.6.1 Extruders may be classified as:

1. Cold forming :mixing and shaping
2. Low – pressure extrusion : cooking and forming at temperatures less than 100 oc
3. High –pressure extrusion : cooking and forming at temperatures greater than 100 oc

Show the different types of extruders used today in the food industry, with some typical operating condition s and typical operating condition and types of food products made in each.

Types of extruders and typical operating conditions

Table2.9 (from frame,1994)principle of food processing (p.254).

	Feed Mois:%	Product Temp(oC)	Screw sp:(rpm)	Typical products
Twin-screw Cooking extruder	11-35	80-200	200-500	puffed snacks RTE cereals Fabricated chips
High- shear	15-20	120-180	350-500	puffed snacks RTE cereals Modified starch
Collet extruder	11-16	170-200	300	puffed snacks
Low- shear cooking Extruder	28	90-150	60-200	RTE cereals soup bases Starch
High –pressure Forming extruder	25	65-80	40	cereal pellets Half-product
Pasta press	32	30-52	30	pasta

Extruders have been used in the food industry for over 50 years (harper, 1989). their use has expanded in recent years for many reasons, including:

1.versatility.

A wide variety of product types and shapes can be processed in an extruder by simply.

2. High throughput.

Since extruders operate best under continuous flow condition, high product throughputs are obtained. This results in a highly efficient and economic process for cooking and forming foods.

3.Low cost.

This high efficiency results in lower costs for many food products. Reduced space on the plants floor and reduced labor requirements.

4.Energy savings.

An additional aspect of processing efficiency is the manner by which foods are cooked. Starchy material can be cooked under high pressure at low water content in an extruder.

5. Product quality.

Extrusion processes are typically high temperature and high pressure for short time duration. This results in products with limited heat treatment that have nearly all the nutritional attributes.

6 Environmental concerns.

Extrusion process limits environmental concerns associated with waste streams.

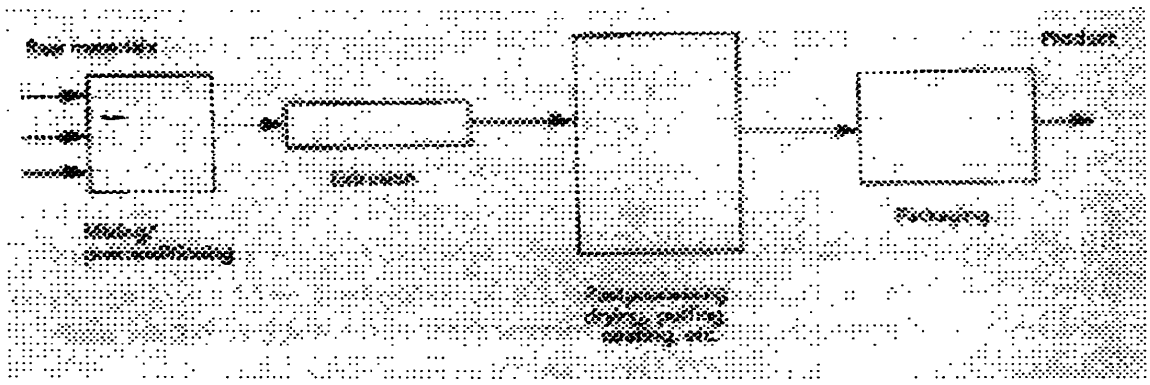


Fig: 2.3 Simple extrusion processing plant.

2.6.2 Extruders and extrusion operation

Extruders can be broadly categorized as single –screw or double screw (twin) types. Diagrams of each type of extruder are shown below.

Single –screw extruders are relatively inexpensive compared to twin –screw extruders, and are used when the flexibility of a twin –screw extruder is not required

(ex. Simple cooking and forming processes). The primary advantage of the twin–screw extruder is that a wide variety of operations can be accomplished within a single extruder by varying the screw configuration processes such as mixing, kneading, and cooking can all be accomplished within a single unit by simply changing the orientation or type of screw elements. Single –screw extruder operation demonstrating the major elements of an extruder. Single-screw extruders consist of a screw rotating within a cylindrical barrel.

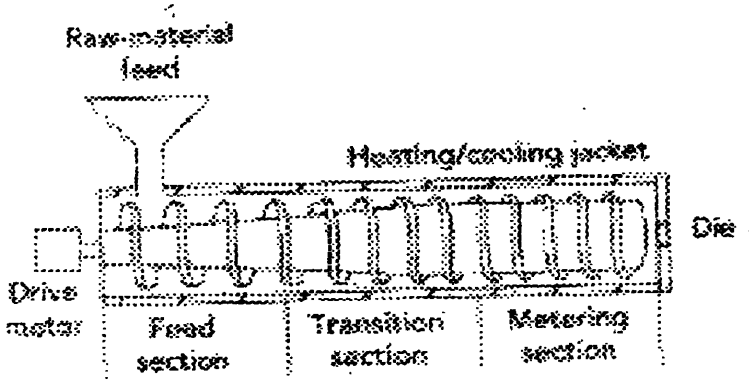
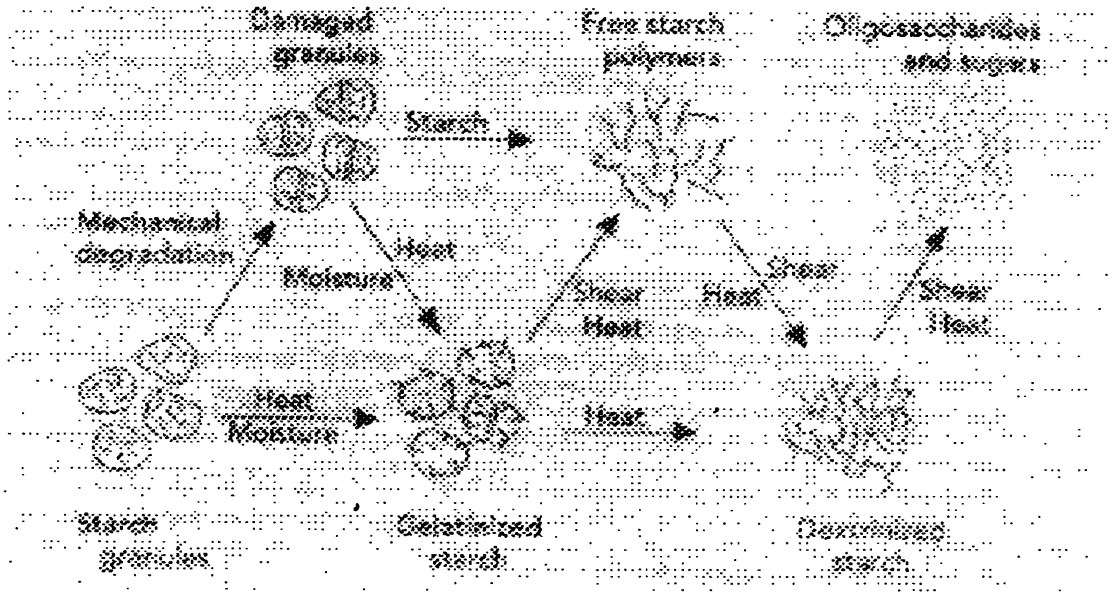


Fig 2.4 Typical operation of a single- screw extruder

2.6.3 EFFECTS OF EXTRUSION ON FOODS

Extruders are used to perform a variety of operations in a single-unit operation. The flexibility to perform a variety of tasks is what makes extrusion unique among food processing operation. Choice of extruder operating conditions determines the process by which raw materials are converted into valued products. The effect of the extruder on the raw materials includes chemical reactions that influence texture, color, and nutritional qualities. One of the primary reactions that occur in extruders is gelatinization of starches. Raw starch-typically from wheat, corn, rice, and potato and in any of variety of forms-is fed into the extruder under controlled moisture and temperature conditions. Starch granules experience both hydration from moisture and disintegration from shear forces, as shown schematically in Figure 2.5. A primary difference in starch modification in an extruder, as compared to simply heating in the presence of moisture, is degradation of the starch molecules into smaller oligosaccharide units due to mechanical forces.



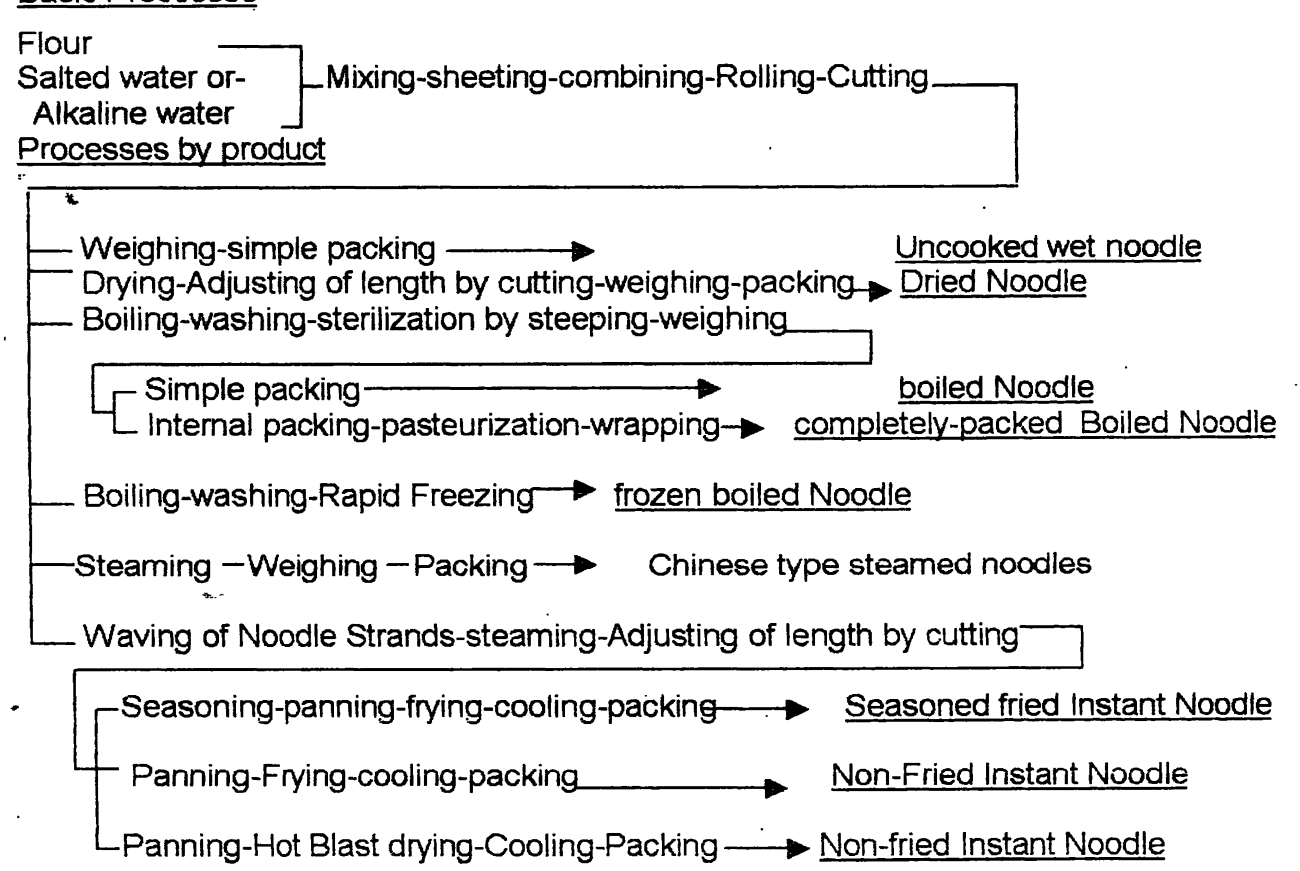
(fig:2.5)Proposed model for starch degradation

2.7 Noodle Processing Technology

2.7.1Basic Processes

Different from that for handmade noodles, the basic process for noodle making by machines mixing raw materials, dough sheeting, and combining of two sheets, rolling and cutting. Noodle stands coming out of cutting rolls are processed into different kind of noodles.

The manufacturing Process of various noodles made by machines is shown in follow.



Manufacturing processes of machine-made noodles. (Fig2.6)

2.7.2 Raw Materials

Formulation for Japanese noodles is simple: flour 100 parts; salt, 2-3 parts; and water, 28-45 parts. The quantity of salt is adjusted according to noodle types, market requirements and climate; dry noodles require more salt (2-3%) than boiled noodles (2%). In water, less salt is required.

Buckwheat flour (30 parts) & hard wheat flour (70 parts) are mixed with water (28 parts) in the manufacture of typical buckwheat noodle. Salt is not used lest the binding capacity of wheat flour and the fresh flavor of buckwheat flour are lost. However, the ratio of wheat flour to buck

wheat flour varies according to the type of product and the quality of buckwheat flour. Shows a horizontal vacuum mixer (capacity of 75 kg flour), which is used to give a little stiffness to the texture of Chinese type noodles or steamed noodles.

2.7.3 Sheeting and Combining

The stiff and crumbly dough pieces are divided into two, & each portion is passed Through a pair of sheeting rolls to form a noodle sheet. The diameter of sheeting roll is usually 180 mm. The two sheets are then combined & passed through a second set of rolls 240-mm in diameter. The roll gap at this stage is adjusted to the thickness of the original sheet to help further development of gluten by pressure at the moment of passing. The combined sheet is usually rested for a period of up to 1 hour for maturing. The effect of maturing at this stage is to soften the dough sheet by stress relaxation, and to make the subsequent rolling operation easy. This combining process is often repeated again at the beginning of the next step to give more complete formation of gluten network.

CHAPTER 3

3.Materials and method

3.1Materials

Kurakkan extruder

Wheat steamer

Rice dryer

Water

3.1.1To the sensory evaluation

Question papers were prepared according to the ranking method (appendix 1) untrained panelist were participated.

1. noodles samples
2. plates
3. serviette paper
4. spoons
5. pens

3.1.2 Proximate analysis

3.1.2.1Determination of moisture

Apparatus

1 metal dish with a lid
2 oven maintained at 105-+2oc
3 desiccator with a suitable desiccater.

3.1.2.2 Determination of the fat

Apparatus

1 soxhelt extraction apparatus
2 oven maintained at 105+-2°c
3 desicator with a suitable desiccant.

Reagent

1.petrolium ether, boiling rang 40°c to 60°c

3.1.2.3 Determination of crude fiber

Apparatus

1 oven maintained at 105°c+- 2°c
2 refluxe condensor
3 burner funnel
4 crucible with a thin
5 compact layer or ignited
6 muffe furnace or ignited asbastons.

7 Muffe fumance, maintained at 550°c+-2°c

Reagents
Sulfuric acid c.(H_2SO_4)
c.NaoH
sodium alchol 95%

3.1.2.4 Determination of ash

Apparatus

1 dish of silica or plentium
2 oven maintained at 105+-2oc
3 muffle fumance maintained at 550oc
4 desicator ,with a suitable desiccant

3.1.2.5 Determination of protein

Apparatus

1 Kjeldahl flasks
2 Kjeltec unit
3 250 ml conical flasks
4 Burette

Reagents

Concentrated sulfuric acid

Catalyst tablets

40% Sodium hydroxide solution

2%Boric acid indicator solution

0.1Msulphuric or hydrochloric acid

3.2 Method

First took kurakkan flour, wheat flour and rice flour and then mixed well. Then added water and made the dough and steamed it. Then sent to the extruder and got noodles strands (length 20-22cm). Finally noodles were steamed, then steamed noodles sent through to the dryer for drying.

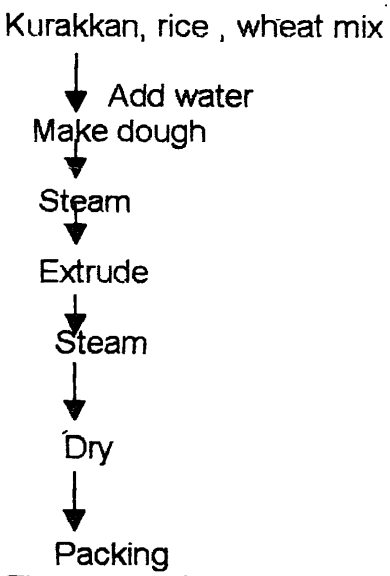


Fig:3.1 Flow chart of the process

3.2.1.Samples preparation

Samples were prepared according to the following formulas in the table .All four types of samples were prepared which different only in amount of ingredient all remain compare were kept the same.

Ingredients	sample212	sample336	sample542	sample471
Kurakkan	20	30	45	60
Wheat	10	10	10	10
Rice	70	60	45	30

3.2.2Method of sensory evaluation

ranking test was used and ranked four sample types.

3.2.2.1.Ranking

The panelist receives three or more coded samples and was asked to rank according the intensity of specific characteristic. The results of ranking test was checked for significant differences by using the tables prepared by Karmer et al.(1974).

The ranking method is rapid and allows the testing of several samples at once. It is generally used to screen one or two of the best samples from a group of samples rather than to test all samples thoroughly.(Larmond,1977).

3.2.2.2.Method

Nineteen judges ranked the four types of noodles using the score sheet in appendix 3 .The results scales given by the judges were shown in table 4.1.

3.2.3. Compare with current market samples

Select the best sample from the prepared samples. After that compared it with the present market **kurkkan** noodles.

3.2.3.1.Method of sensory evaluation

All 3 samples were ranked using ranking test under three parameters.

3.3 Proximate analysis

3.3.1Determination of moisture

The metal dish was dried in the oven for 30 minutes and cooled in a desiccater and weighed to the nearest milligrams. The metal dishes were weighted (m1) and put in samples and got the weight of both (m2) the samples were dried for four hours at 105°c in an oven. Then cooled in a desiccater and weighed (m3) this process of drying, cooling and weighing were repeated for 30 minutes intervals until the different between two successive weights were not exceed 1mg.

Note: reserved the dried material for determination of fat percentage

Calculation
Moisture percent by mass =(m2-m1)-(m3-m1)/(m2-m1)*100

3.3.2 determination of fat

The soxhlet flask in the oven was dried in the oven and cooled in a desiccator and weighed (f). The sample was weighed (m) then dried and transferred into a suitable thimble. The soxhlet apparatus was extracted with petroleum ether for 10 hours. Then the solvent was evaporated. The flask was dried in the oven. Cooled in a desiccator and weighed (f1) this process of drying cooling and weighing was repeated for 30 minutes intervals until the difference between two successive weighing does not exceed 1 mg.

Calculation
Fat % by mass =(f1-f)*100/(m)

3.3.3 Determination of protein

The kjeldahl method determine the total nitrogen present as -NH- in the food.That is true protein N, amino N and amide N .

Calculation

Crude N% $= \frac{0.0014 * \text{required vol:strand } H_2SO_4\text{ml (0.1N)8strenth of acid} * 250 * 100}{0.1 * \text{weight of the sample} * 25}$

crude protein =6.25*crudeN%

3.3.4Determination of crude fiber

The sample was weighed (m1),defatted sample was dried and then was transferred into one liter beaker, 200ml of 0.128mol/l sulfuric acid was boiled and the weighed sample was added and boiled for 1 minute .The sample was poured into the funnel and washed with boiling water until the washings were no longer acidic .Then 200ml of 0.128 mol/l NaoH was boiled and added the sample into the flask and boiled for one minute . then the boiled sample was washed with water until the alkalinity was removed. The residue was transferred into boiling water and transferred into the crucible. the residue was washed with hot water thoroughly and then washed with 15ml of ethyl alcohol. The sample was transferred into the oven and dried upto a constant weight (m2).The crucible was transferred in the furnace and the content of crucible were incinerate and the sample was cooled in a desiccator and weighed to the nearest mg(m3).

Calculation

Crude fiber %by mass =(m2-m3)*100/(m1)

3.3.5.Determination of ash

The crucible was weighed (m1)and sample was weighed (m2). Kept for 1hour in the oven at 105°c then the sample was placed in the muffle furnace and was ignited at 550°c+-2°c until a gray ash color was obtained then the crucible was cooled in a desiccator and weighed (m3) this process was repeated until the different between successive weighing were not exceed 1mg.

Calculation

Total ash %by mass =(m2-m1)*100/(m3-m1)

CHAPTER 4

Results and Discussion

4.1 Results

4.1.1.Results of ranking method

Table 4.1

Jug	sample471	sample524	sample212	sample336
1	1	3	2	4
2	2	1	4	3
3	1	2	3	4
4	2	1	3	4
5	3	1	4	2
6	3	1	2	4
7	3	1	2	4
8	1	2	3	4
9	3	1	2	4
10	1	3	2	4
11	2	1	3	4
12	2	1	3	4
13	1	3	2	4
14	1	2	3	4
15	1	2	3	4
16	1	2	3	4
17	2	3	1	4
18	1	2	3	4
19	1	3	2	4
Total	31	35	50	73

The rank totals are compared with the values in the appendix 3. When there are four samples and nineteen judges (reps.) the tabular entries are 37-58, the lowest insignificant rank sum is 37and the highest insignificant rank sum is 58. If one or more rank sums are higher than upper left value in the block (37) or higher than upper right value of the block (58) statistical significance at the 5% level of significance is indicated. But two ranks sums are lower than 37 (lower rank sum) they are 471 and 524 and are significantly better than 212 and 336.

Here 524 was selected from other samples considering the low cost and stability of texture.

4.1.2 Comparison of market leaders

Table 4.2

Jug	sample561	sample678	sample123
1	3	1	2
2	3	1	2
3	1	3	2
4	1	2	3
5	3	1	2
6	1	2	3
7	2	1	3
8	3	1	2
9	1	2	3
10	2	3	2
11	2	3	1
12	2	1	3
13	2	1	3
14	3	2	1
15	2	1	3
16	1	2	3
17	2	1	3
18	1	2	3
19	1	2	3
Total	36	32	47

The rank total are compared with the values in appendix as in 4.1.1.rank totals in table 4.2 are laid with in 32-44 which is tabular value for 19 judges and three samples (see appendix3) the conclusion is that there is no significant difference between selected sample and the market sample (561).

4.1.3 Result of proximate analysis

Best sample was analyzed for

Moisture

Total ash

Crude fiber

Crude fat

Protein

Starch

And the results are as follows.

Composition of the best sample
Table 4.3

Compound	percentage
Moisture	8.57
Total ash	1.63
Crude fiber	8.78
Crude fat	1.76
Protein	8.31
Starch	71.18

Then consider of the SLS requirements for noodles products as follow.
Table 4.4

Moisture	12.0
Total ash	1.0
Total protein	10.0

(Sri Lanka Standards 420:1989)

The selected best sample was compared with the SLS, moisture and protein are some of lack than SLS.

CHAPTER 5

5.1 Conclusion

With the results of this study following conclusions can be made.

1 Maximum level of the **kurakkan** flour we can incorporate into noodles is 45% over that noodle become more dark and no accessibility, also the texture also will not retain well. We can't obtain the real stability.

2 Due to the 8.78% of fiber content can retain a larger period in the digestive system. Also **kurakkan** is identified as a good source for diabetic patient . It has the ability to convert starch to sugar slowly, so we can suggest this **kurakkan** noodles as a healthy food to diabetic patient.

Further studies and recommendation

To develop the product further following recommendations can be made

1 Studying of the shelf life of the product.

2 improving the moisture content up to the S.L.S.

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APPENDIX 1

SENSORY EVALUATION FOR RANKING TEST

NAME: DATE:

PRODUCT:

INSTRUCTION

- Please taste these samples in the following order.

212 336 471 524

- Give the score for each characteristics of the product better one is "1" then "2"."3"and "4".
- Please check these characteristics such as **taste**, **appearance** and **texture**.

	Appearance	Taste	Texture
First	☐	☐	☐
Second	☐	☐	☐
Third	☐	☐	☐
Fourth	☐	☐	☐

Comments

Thank you!

Appendix 3 : Statistical chart

Rank totals

Rank total required for significance at the 5% level (p<=0.05 .the four figure blocks represent; lowest insignificant rank sum , any treatment – highest insignificant rank sum, any treatment .lowest insignificant rank sum , predetermined treatment – highest insignificant rank sum predetermined treatment .

No.of reps.	No. of Treatments or sample ranked								
	2	3	4	5	6	7	8	9	10
2	.....	.....	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	3-9	3-11	3-13	4-14	4-16	4-18
3	.....	.....	.....	4-14	4-17	4-20	4-23	5.25	5-28
	.....	4-8	4-11	5-13	6-15	6-18	7-20	8-22	8-25
4	.....	5-11	5-15	6-18	6-22	7-25	7-29	8-32	8-36
	.....	5-11	6-14	7-17	8-20	9-23	10-26	11-29	13-31
5	.....	6-14	7-18	8-22	9-26	9-31	10-35	11-39	12-43
	6-9	7-13	8-17	10-20	11-24	13-27	14-31	15-35	17-38
6	7-11	8-16	9-21	10-26	11-31	12-36	13-41	14-46	15.51
	7-11	9-15	11-19	12-24	14-28	16-32	18-36	20-40	21-45
7	8-13	10-18	11-24	12-30	14-35	15-41	17-46	18-52	19-58
	8-13	10-18	13-22	15-27	17-32	19-37	22-41	24-46	26-51
8	9-15	11-21	13-27	15-33	17-39	18-46	20-52	22-58	24-64
	10-14	12-20	15-25	17-31	20-36	23-41	25-47	28-52	31-57
9	11-16	13-23	15-30	17-37	19-44	22-50	24-57	26-64	28-71
	11-16	14-22	17-28	20-34	23-40	26-46	29-52	32-58	35-64
10	12-18	15-25	17-33	20-40	22-48	25-55	27-63	30-70	32-78
	12-18	16-24	19-31	23-37	26-44	30-50	33-57	37-63	40-70
11	13-20	16-28	19-36	22-44	25-52	28-60	31-68	34-76	36-85
	14-19	18-26	21-34	25-41	29-48	33-55	37-62	41-69	45-76
12	15-21	18-30	21-39	25-47	28-56	31-65	34-74	38-82	41-91
	15-21	19-29	24-36	28-44	32-52	37-59	41-67	45-75	50-82
13	16-23	20-32	24-41	27-51	31-60	35-69	38-79	42-88	45-98
	17-22	21-31	26-39	31-47	35-56	40-64	45-72	50-80	54-89
14	17-25	22-34	26-44	30-54	34-64	38-74	42-84	46-94	50-104
	18-24	23-33	28-42	33-51	38-60	44-68	49-77	54-86	59-95
15	19-26	23-37	28-47	32-58	37-68	41-79	46-89	50-100	54-111
	19-26	25-35	30-45	36-54	42-63	47-73	53-82	59-91	64-101
16	20-28	25-39	30-50	35-61	40-72	45-83	49-95	54-106	59-117
	21-27	27-37	33-47	39-57	45-67	51-77	57-87	63-97	69-107
17	22-29	27-41	32-53	38-64	43-76	48-88	53-100	58-112	63-124
	22-29	28-40	35-50	41-61	48-71	54-82	61-92	67-103	74-113
18	23-31	29-43	34-56	40-68	46-80	51-93	57-105	62-118	68-130
	24-30	30-42	37-53	44-64	51-75	58-86	65-97	72-108	79-119
19	24-33	30-46	37-58	43-71	49-84	55-97	61-110	67-123	73-136
	25-32	32-44	39-56	47-67	54-79	62-90	69-102	76-114	84-125

Source: Modified from Larmond, 1977

APPENDIX 2

SENSORY EVALUATION FOR RANKING TEST

NAME: DATE:

PRODUCT:

INSTRUCTION

- Please taste these samples in the following order.

123 561 678

- Give the score for each characteristics of the product better one is "1" then "2" and "3".
- Please check these characteristics such as **taste**, **appearance** and **texture**.

	Appearance	Taste	Texture
First	☐	☐	☐
Second	☐	☐	☐
Third	☐	☐	☐

Comments

Thank you!

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