EXTENDING THE SHELF LIFE OF FRESH NOODLES AT THE AMBIENT TEMPERATURE

BY

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Declaration

The research work described in this thesis was carried out at the Ceylon Agro Industry (Pvt) Ltd, and the Faculty of Applied Sciences, under the supervision of Mr. Premasiri Fonseka and Mrs. W.M.D.Priyadarshani.

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Affectionately Dedicated

to

My Ever Loving Parents

and Teachers

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ABSTRACT

Fresh noodles, called as "Hokkien" in Malaysia, is a semi processed food product widely used in Asian countries like Malaysia, China and Japan. Product contains high moisture content and hence limit its shelf life at ambient condition. Within 2-3 days it begins to swell and appears to have yeast and moulds on packaging and noodles surface. Therefore this study was carried out to identify best preservation method to extend shelf life of Hokkien noodles at ambient condition.

Experiments were initiated with a sterilizing fresh noodle processing environment and machine with hot water, chlorinated water (50ppm), pure alcohols and effectiveness was evaluated by swab method. The effect of chemical preservatives were evaluated using Sodium carbonate and potassium carbonate, Potassium sorbate, calcium propionate, Acetic, Glycine, and Lactic acid in the range of (0.6%, 0.4%, 0.1%, 0.2%, 0.2%, 0.5% and 0.1-0.5%) respectively. Additional processing step was carried out as steeping, combinations with potassium sorbate and glycine, sorbate, glycine, acetic and combination of Glycine and acetic. Chemically treated sample were vacuum packed and treated under micro wave separately. Gamma irradiation of samples at dose; in 0.2 KGy,0.4 KGy,0.6 KGy,0.8 KGy,1 KGy,2 KGy,3 KGy,4 KGy,5 KGy were carried out and UV treatment was also carried out to check its effect on shelf life extension. The preservation quality of each treatment was evaluated by physicochemical and microbiological assessment of the sample. The preliminary market survey was conducted to determine potential market for Hokkien noodles in Sri Lankan market.

Sanitation shows greater reduction in microbial load and hence reducing risk of contamination. Among chemical preservatives combination of glycine and acetic with vacuum pack and microwave sample gave the good preservative action keeping the noodles for 17 days without change on physicochemical and microbial quality.

UV treated sample had 11 days of storage period. Preliminary market survey reveals the potential demand to Hokkien noodles (91%) in the market.

Gamma irradiation was seemed to be more effective in preserving noodles at ambient temperature. Sample treated with 5KGy shows no change in physicochemical and microbial growth for 34 days storage at ambient temperature.

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ABBREVIATIONS

APP : Appendix

Hrs : Hours

mm : mili meter

US : United States

g : Gram

mts : minutes

^{0}C : Celsius

ppm : parts per million

Et al : And other

MHz : Mega Hurt's

IR : Infra red

UV : Ultra Violet

Nm : nano meter

Hz : Hurts

ev : Electron Volt

A^0 : Angstrom unit

FDA : Food and Drug Administration

KGy : Kilo Gray

WHO: World Health Organization

Ml : mili liter

L : Liter

Psi : Pressure square inch

MPN : Most probable Number

cfu : Colony forming unit

TPC : Total Plate Count

CHAPTER 1

INTRODUCTION

1.1 Introduction

To meet growing variations in demand and increasingly specific requirements created by the changing life styles of consumers, the food industry need to display a huge capacity for innovations and continuous improvements (Linden and Lorient, 1999). Nowadays people are live in a complex and complicated society, having limited time to spend at cuisine. So that people with busy life style always look for convenient foods with easy preparation and serving. Therefore the processed food market is always changing in order to suit with customer preferences. Wheat flour noodles on many convenient forms are now available in the market and manufactures try to become market leaders introducing many novel types of noodles.

Wheat flour noodles are an important part in the diet of many Asians. It is believed that noodles are originated in China as early as 500BC, and then spread to other Asian countries. Today the amount of flour used for noodles making in Asia accounts for about 40% of the total flour consumed (Guoquan and Kruk, 1998). Asian noodles are characterized by thin strips slit from a sheeted dough that has been made from flour (hard and soft wheat), water and salt (common salt or alkaline salt). Wheat flour is the main ingredient for making noodles, about 3 parts of flour are usually mixed with one part of salt to form a crumbly dough. The dough is compressed between a series of rolls to form a dough sheet. The gluten network is developing during sheeting process, contributing to the noodle texture. The sheeted dough is then slit to produce noodles (Guoquan and Kruk, 1998).

No systematic classification is available for Asian noodles nomenclature; while they are classified based on raw materials, salts, size and processing method. Noodles can be classified as fresh, dried, boiled and steamed based on its processing conditions.

According to Matz (1996), fresh noodles are type of semi processed foods called as Hokkien in Malaysia. Wheat flour is the major ingredient in fresh noodles manufacture. The product contains high amount of starch, protein, moisture, lipid and

small amount of cellulose and ash. With its semi processed condition product contains high moisture content showing high water activity could harbour many undesirable microorganisms, limiting its shelf life. Therefore storage of fresh noodles at ambient condition is not applicable, but ambient storage of noodles is an essential feature in the market.

Therefore this study is focused on identifying a preservation method for fresh noodles with its premited shelf life for about 2 months.

The shelf life of noodles varies with moisture content, formulation, processing techniques, packing, handling and storage condition (Pomeranz 1988). Usually, to increase the shelf life of a food product, processors primarily prompted towards preservatives. In addition some other techniques are also available. Microwaving the product is one of them and it aids to remove moisture and to destroy micro organisms responsible for spoilage (Cauvain and Young, 2000). Changing the packaging and processing methods and processing foods with UV and gamma irradiation techniques that is seem to be a new approach are the another alternatives. These techniques could be used individually or in combination in order to extend the shelf life of the product.

1.2 Overall Objective:

To extend the shelf life of the fresh noodle at ambient temperature while maintaining the desirable sensory and microbiological quality.

1.2.1 Specific Objectives:

(1) To identify the steps where contaminations and occurrence of residual micro flora is possible in finished fresh noodle.

(2) To modify the production process so as to eliminate contamination or residual micro flora.

(3) To determine the most effective and affordable preservation technique.

(4) To evaluate physico-chemical and microbiological parameters of fresh noodle with best preservation method.

(5) To carry out a market research on fresh noodles.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Characteristics common to noodles.

Noodles products often contain not only the basic ingredients of water and flour, but other ingredients such as salt, alkaline reagents, artificial coloring agents and preservatives. Specifications of wheat flour required for nondurum noodles depend on local or regional preferences for noodle colour, eating texture, flavour, shelf life and ease of preparation for consumption (Pomeranz, 1988).

Regional preferences exist for noodle clarity, or brightness, yellowness, whiteness, softness, firmness or chewiness and flavour, the specific preferances depend on eating habits or expectations associated with accepted quality standards for a given noodles shape or type (Karim,1990).

Noodles flavour, texture and appearance depend not only on flour characteristics but also on the specific process used to manufacture the noodle as well as the inclusion of other raw material or chemical additives. Noodles made from low protein flour generally have a soft bite compared to those made from high protein flour. The shelf life of noodles varies with moisture content, formulation, processing techniques, packing, handling and storage condition (Pomeranz, 1988).

2.1.1 Definition of the noodles

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

2.2 Noodle Types

Popular noodle types include fresh (raw, Cantonese style), wet or boiled (Hokkien style), dried, steamed and dried (traditional instant), boiled and fried (Yimee), and steamed and fried (instant, Remen style). Each noodle type has at least one unique step in processing that make it differ from the others, although must noodle type share the common processing steps of mixing, kneading, rolling or sheeting and cutting (Karim,1990).

Raw noodles are sold in the medium moisture state (approximately 35% moisture), where as wet noodles are parboiled to approximately 55% moisture, rinsed and cooled with fresh water, and coated with vegetable oil to prevent sticking. Both wet and raw noodles have relatively short shelf life ranging from a few hours to several days, depending on formulations, packing, and storage conditions (Pomeranz, 1988).

Fresh noodles are usually produced with a thin cross section, which allow them to cook rapidly. They are made from relatively strong flours, so they can handle in the wet form. This gives the cook noodles to chewy texture (Hoseney, 1994).

2.3 Classification of Asian noodles

2.3.1 Classification on the basis of raw materials, salts, size and processing methods

Based on the raw materials

Noodles can be made from wheat flour alone or in combination with buckwheat flour noodles include Chinese and Japanese type noodles. Noodles containing buckwheat are called as "soba", meaning "buckwheat noodles". These are typically light brown or gray in color with a unique taste and flavour (Guoquan and Kruk, 1998).

Chinese type noodles are generally made from hard wheat flours, characterized by bright creamy white color or bright yellow color and firmer texture. Japanese noodles are typically made from soft wheat flour of medium protein. It is desirable to have a creamy white color and a soft and elastic texture in Japanese noodles (Guoquan and Kruk, 1998).

Based on salt used

Based on the absence or presence of alkaline salt in formula, noodles can classify as white (containing salt) noodles or yellow (containing alkaline salt) noodles. Alkaline gives their characteristics yellowness. White salt noodles comprise Japanese noodles, Chinese raw noodles or dry noodles. Chinese wet noodles, Hokkien noodles, Cantonese noodles, Chuka men, Thaibamee and Instant noodles fall under the yellow alkaline noodle category (Guoquan and Kruk, 1998).

Based on size

Noodles can be classified in to very thin noodles, thin noodles standard noodles and flat noodles. Square shape and round shape noodles strands are available but most popular

one is a square shape noodle. According to the width of the noodle strands, Japanese noodles are classified in to 4 types

Table: 2.1 Classification of Noodles based on width

Name	Characteristics
So-men	Very thin, 0.7-1.2mm wide
Hiya-mughi	Thin, 1.3-1.7 mm wide
Udon	Standard
Hira-men	Flat, 5.0-6.0 mm wide

So-men and Hiya-mughi noodles are usually served cool in the summer, and Udon and Hira-men are often eaten hot in the cool seasons.

Based on processing

Simplest way to classify noodles based processing is hand-made versus machine made noodles. Hand made type still available in Asia because of their favorable texture.

Table: 2.2 Classification of Noodles based on the processing

Noodle type	Processing
Fresh	Noodles strands are coming out of slitting rolls are cut in to certain lengths for packing without any further processing. These are often consumed within 24 hrs of manufacture due to quick discoloration. Their shelf life can be extending 3-5 days of stored under refrigerator. Ex: Chinese raw noodles, Udon, Chuka-men, Thai bamee, Cantonese, Soba
Dried	Fresh noodles are dried by sunlight or in a controlled chamber. Noodle shelf life is dramatically extended, but fragile noodle may have handling problem. Ex: Cantonese noodles, Chuka-men, Udon and soba can be in dried form
Boiled	Fresh noodles strands are either parboiled (90% complete cooking) or fully cooked. After parboiling noodles are rinsed in cold water, drained and coated with 1-2% vegetable oil to prevent sticking. Ex: Chinese wet noodles, Hokkien noodles, Udon and Soba.
Steamed	Fresh alkaline noodle strands are steamed in a steamer and softened with water through rinsing or steeping, and it is often prepared by stir-frying for consumption. Ex: Yaki-Soba

Source (Guoquan and Kruk, 1998).

2.3.2 Classification of noodles by the form of product in the market

Uncooked wet noodles

The most popular form of noodles sold to retail shops and restaurants in fresh and uncooked form. Uncooked wet noodles have to cook prior to consumptions (Dick.1996).

Boiled Noodles

Noodles strands are boiled and it is sold unpacked, simply packed, or completely packed. Due to the packing condition the shelf life of the products is varies (Dick.1996).

Steamed Noodles

This type of noodles is steamed instated of boiling. They are saved with several kinds of vegetables (Dick.1996).

Instant Noodles Packed in Polyethylene Bag

Noodles strands gelatinized in a steamer are dried by frying or by hot blast drying, the product of which are classified in to fried instant noodles and non- fried instant noodles, respectively. Two types of fried instant noodles are available. In one type, the noodles are flavored with all the seasoning, while the other is a plain type in taste accompanied by a separated pack of soup base (Dick.1996).

Instant cup noodles

The product are packed in cup or in a bowl made of Styrofoam with dried soup base, vegetables, and shrimp sand meat. Cup noodles can be eaten simply pouring hot water in to the cup or the bowl. (Dick, 1996).

Hokkien Noodles

Fig 2.1 Hokkien noodles

In traditional manual transfer operations, noodles were cut to length before batch wise boiling for 30-60 second and rinsing by immersion in tap water at ambient temperature. In automated plants, uncut noodles pass through boiling water batch for 30-40 seconds before rinsing with water at ambient temperature. Water condition of the batch is the prime importance as there may be accumulation of starch, dextrins, alkaline salt and other material, which at a high pH result in increased cooking loss and stickiness of the noodle surface.

2.4 Quality of Wheat used in noodles

2.4.1 Sources

The key noodles wheat growers and suppliers are the United States, Australia and Canada. In the US, hard red spring, hard red winter, soft red winter and soft white wheat are used alone or blended for making noodle flour (Guoquan and Kruk, 1998).

2.4.2 Quality requirements

Wheat should be clean and sound, high in test weight, and uniform in kernal size and hardness. These characteristics result in efficient milling and high flour extraction and possibly, optimum quality end products (Cornell and Hoveling., 1998)

Damaged starch not only absorbs more water but may also reduce noodle cooking and eating quality. So noodle wheat should not be too hard, and milling processes should be controlled to avoid excess starch damage. Different noodle type requires different protein content and dough strength. Chinese type noodles need hard wheat of high protein content and strong gluten, and Japanese noodle requires soft wheat of medium protein content (Guoquan and Kruk, 1998).

2.4.3 Flour quality characteristics

Each noodle type requires its own specific flour quality criteria, flour protein, ash content, flour-pasting characteristics are major specifications. Protein content varies according to the noodle type to achieve the desired eating quality. Generally flour protein content has a positive correlation with noodle hardness and a negative correlation with noodle brightness. Thus there is optimum flour protein content required for each noodle type. Japanese udon noodles require soft wheat flour of 8-9.5% protein. Other noodles requires soft wheat flour of high protein content (10.5-13%) giving a firmer bite and springy texture (Guoquan and Kruk, 1998).

Flour ash content has been rated as one of the important specification, because it affects the noodle colour negatively. Wheat with an ash content of 1.4% or less is always an

advantage. Most noodles flours require ash content below 0.5%, but premium quality noodles are often made from flour of 0.4% or less ash (Cornell and Hoveling, 1998).

Starch pasting characteristics also play an important role. The ratio of amylose to amylopectin content determines starch-pasting characteristics (Guoquan and Kruk, 1998).

2.4.4 Flour microbiology

The flour itself needs to be tested for microbial contamination by taking various samples and culturing them on agar gels containing the required nutrients. Bacterial counts are generally seen as numbers ranging from 10^3 to 10^5 colony forming units/g. Occasionally flour will be contaminated and much higher counts will be obtained, leading to unpleasant odor and hence complaints, usually up to 600/g will also be observed and sometimes wild yeast. Many different species of moulds are found in flour. *Aspergillus glaucus, A.candidus* and *penicillium* are perhaps the most common. Heavily infested wheat or flour displays poor color and baking quality and off flavors can be detected (Pitt and Hocking, 1999).

2.5 Noodle Processing Technology

Major steps involve mixing raw materials, resting the crumbly dough, gradually sheeting the dough sheet in to a specified thickness and slitting in to noodle strand (Guoquan and Kruk, 1998)

2.5.1 Mixing Ingredients

Mixing of ingredients is often carried out in a horizontal or vertical mixer for 10-15 minutes. Since the horizontal mixer seems to have better mixing results, it is more commonly used than the vertical one in commercial noodle production (Dick.1996).

Mixing results in the formation of crumbly dough with small and uniform particle sizes. Gluten development in noodle dough during mixing is minimized. This improves the dough sheetability, smoothness and uniformity (Guoquan and Kruk, 1998).

2.5.2 Dough Resting

After mixing the dough pieces are rested for 20-40 mts, it helps water penetrate in to dough particles evenly, resulting in a smoother and less streaky dough after sheeting (Dick.1996).

2.5.3 Sheeting, slitting and waving

Noodle slitting is done by cutting machine, which is equipped with a pair of calibration rolls, a slitter and a cutter or waver (Guoquan and Kruk, 1998)

2.5.4 Cooking

Cooking process include parboiling, boiling and steaming. Hokkien noodles and Chinese wet noodles are usually parboiled for 45-90 seconds to achieve 80-90% gelatinization in starch (Guoquan and Kruk, 1998)

2.6 Cleaners and Sanitizers

2.6.1 Hot water

Immersion of small components in to water heated to 80^{0}C or higher is another thermal method of sterilization. Pouring hot water in to the container is not reliable sterilizing method, because of the difficulty of maintaining the water temperature high enough to ensure adequate sterilization (Marriott, 2001).

2.6.2 Active chlorine

Chlorine in the form of hypochlorite solution with broad range of antimicrobial activity which include spores. The active species is hypochlorite which is present in aqueous solutions at pH 5-8. Active chlorine such as sodium or potassium hypochlorite, are effective in the removal of carbohydrate and/or proteinaceous soils. Also may effective in removing molds from the surfaces (Marriott, 2001).

2.6.2.1 Advantages of chlorine compounds over other sanitizers.

- They are effective against a variety of bacteria, fungi and viruses
- Use concentration 50ppm
- They are the cheapest sanitizers
- Toxic by products are not produce (Marriott, 2001).

2.6.3 Alcohols

Ethanol, a coagulant and denaturizer of cell proteins, is most germicidal in concentration 70% and 95%.

2.7 Chemical Preservatives

The addition of chemicals to food is not a recent innovation, but has been practiced throughout recorded history. Preservatives are defined as "Substances capable of inhibiting, retarding or arresting the growth of the micro organisms or of any deterioration resulting from their presence or of masking the evidence of any such deterioration" (Adams and Moss, 2003).

2.7.1 Potassium carbonate and Sodium carbonate

- **Sodium Carbonate**

Na_2CO_3, soluble in water and very slightly soluble in alcohol. Pure sodium carbonate is a white, odorless powder that absorbs moisture from the air, has an alkaline taste, and forms a strongly alkaline water solution. It is one of the most basic industrial chemical. Sodium carbonate decahydrate, $Na_2CO_3 \cdot 10H_2O$, is a colorless, transparent crystalline compound called sal soda or washing soda (Access: http://www.hoslink.com/Ellis / SODCAR. htm.).

- **Potassium carbonate**

K_2CO_3, White powder called as Potash. Keep away from acids and moisture. Store in a cool, dry atmosphere away from acids or moisture.
(Access: http://www.hoslink.com/Ellis/POTCAR.htm).

2.7.2 Calcium propionate

Calcium Propionate is used to reduce the possibility of mould development in feeds. It is more effective in an acidic environment. Feeds and feed ingredients are generally slightly acidic (pH of 6 or less), which helps in this regard. The amount of calcium propionate used usually depends on the moisture content of the material being protected (Mycoban and Dykon, 2000).

Among the advantages of using calcium propionate is:

1. It is a free-flowing powder, which blends easily with feeds.
2. It is non-toxic to animals.
3. It does not have a harsh odor.
4. It prolongs the shelf life of feeds.
5. It helps prevent molds from changing the composition of feeds.

2.7.3 Potassium sorbate

In the United States of America, Japan and Europe and almost all of the other countries of the world Sorbic acid and Potassium sorbate are a legally permitted preservative because of their outstanding physiological properties. Potassium sorbate can only protect product from attack by mold, yeast and bacteria if the food product has been processed under hygienic conditions. Already infected or partially perished food products cannot be protected through the addition Potassium Sorbate. Potassium Sorbate are mold inhibitors. It inhibit mold from growing. They do not kill already established mold. Potassium Sorbate are considered by the Food and Drug Administration to be generally recognized as safe (GRAS); therefore, the only limitations on their use is that the quantity not exceed the amount reasonably required to accomplish the desired preservative function. Sorbate is a practically odorless white powder that is also available in a dust free granule.

2.7.4 Acetic acid

Acetic acid in the form of vinegar used in mayonnaise, pickle. It is more effective against yeast and bacteria than against molds. At lower pH values it is more effective as undissociated acid (Sivasankar, 2003).

The liquid is a corrosive substance, a splash will cause severe burns to exposed areas of the body. A liquid splash to the eye can cause permanent eye damage. Swelling and blistering can occur to the skin. Skin contact can cause sensitisation in some individuals. The vapour is also corrosive and will cause severe irritation to eyes and the respiratory tract. Prolonged eye exposure to vapour can cause conjunctivitis. Inhalation of vapour or droplets may cause bronchitis, pneumonia and pulmonary edemas. Ingestion of liquid will cause dental erosion, bronchitis and respiratory difficulties. Prolonged exposure to vapour can lead to dental erosion, skin thickening and discolouration. Worksafe Australia odour threshold for acetic acid is 0.2 to 1 ppm (Access : http://www.hoslink.Com/Ellis/ACETAC.htmm).

2.7.5 Lactic acid

Lactic acid is a by-product of anaerobic glycolysis. CH_3 $CHOHCO_2$ H, a colorless liquid organic acid. It is miscible with water or ethanol. Lactic acid is a fermentation product of lactose (milk sugar); it is present in sour milk, koumiss, leban, yogurt, and cottage cheese. The protein in milk is coagulated (curdled) by lactic acid. Lactic acid is produced commercially for use in pharmaceuticals and foods, in leather tanning and textile dyeing, and in making plastics, solvents, inks, and lacquers. Although it can be prepared by chemical

synthesis, production of lactic acid by fermentation of glucose and other substances is a less expensive method. The ability of lactic acid bacteria to produce antimicrobial substances has historically being used to preserve foods. (Salminens and Wright, 1996)

2.7.6 Glycine (NH_2CH_2COOH)

White, crystalline powder. Combustible substance, keep away from heat or naked flames. Store in a cool, dry atmosphere away from heat or naked flames.

(Access: http://www.hoslink.com/Ellis/GLYCINE.htm)

2.8 Vacuum package

Changing the concentration of environmental gases that surround the food has been used in recent years to control spoilage and pathogenic microorganisms. It has also been used to prevent or stop quality degrading oxidative chemical reactions. The alteration in air may result in vacuum packaging.

Vacuum package may be defined as the packaging of products in a higher barrier package from which air is removed to prevent growth of aerobic spoilage organisms, shrinkage, and oxidation and colour deterioration (Padilla and Zakaur, 2001).

2.9 Microorganisms leading to spoilage

Microbiological spoilage caused by yeast, mould and bacteria.

2.9.1 Moulds: Growth on foods as its fuzzy or cottony appearance sometimes colored is familiar to everyone and usually food with a moldy or mildew food is considered unfit to eat (Frazier and Westhoff, 1995).

2.9.2 General characteristics of moulds

Multicellular, filamentous fungi growth on the foods usually is readily recognized by its fuzzy or cottony appearance. The main parts of the growth commonly appears white but may be colored or dark or smoky (Frazier and Westhoff, 1995). Yeast: Generally not filamentous but unicellular and ovoid or spheroid and which reproduce by budding or fission. Yeast may be useful or harmful in food.

2.9.3 Bacteria: Microscopic in nature cannot be seen by naked eye. (Frazier and Westhoff, 1995).

2.10 Characteristics of radiation used for food preservation

2.10.1 Micro wave radiation

In recent years the use of micro wave radiation has become popular for food industry for thawing, drying and baking foods as well as for the inactivation of micro organisms in the foods. Microwave extend this food preservation by reducing microbial cell in the food (Woo et al., 2000). The micro wave region of the electromagnetic spectrum occupies frequency between 10^9 Hz up to 10^{12} and thus have relatively low quantum energy. Two frequencies used in food processing, 2450 MHz and 915MHz, account for around 10^{-18} ergs or 10^{-6} ergs respectively.There has been limited application of micro wave blanching of fruit and vegetables and in the pasteurization of soft bakery products and moist (30%) pasta to destroy yeast and moulds (Adams and Moss, 2003).

2.10.2 UV Radiation

UV Light

Generated by the sun and it is part of the light spectrum. The full spectrum includes radio waves, IR, Visible light, UV, X-rays, Gamma rays, Cosmic rays. UV radiation have wave length below 450nm (Frequency 1015Hz) and a quantum energy of 3-5 eV(10-12 ergs) (Adams and Moss, 2003). One physical method of sterilization of surfaces, equipment, and food products is the use of UV energy. The UV spectrum includes wavelengths between 100nm and 400nm; it can be subdivided in to 4 sections: UVA, UVB, UVC, and the vacuum UV range (Canovas et al., 1998).

UVC section is range from 200-280nm, due to its antimicrobial activity. Within this UV range, the wavelengths around 260nm are the most effective in inactivating bacteria and viruses. UV light is a Powerful bactericidal agent. Most effective wavelength being about 260 nm/2600 A^0 .It is non-ionizing and absorbed by protein and nucleic acid; photochemical changes are produced lead to cell death. Mechanism of UV death in bacterial cell is due to the production of lethal mutations as a result of action on cell nucleic acid (Jay, 2003).

Poor penetrative capacities of UV light limits its application to food surfaces, where it may catalyze oxidative changes that lead to rancidity, discoloration, and other reactions. Small quantities of ozone may also be produced when UV light is used for the surface treatment of certain foods. UV light is some times used to treat the surfaces of baked fruitcakes and related products covered by wrapping (Jay, 2003).

Application of UV Light

- **Sterilization within the food industry.**

Within the advent of packaged goods, the food processing and distribution industry has required a way to ensure the safety and longevity of their products. Food packaging is routinely and safely sterilized using ultraviolet radiation. They are also less penetrative in that they eliminate 99% of product contamination without affecting sub surface tissues. Another benefit is does not transfer heat energy to target foods. Thus there is no adverse health effect on taste (Mathew, 1999).

Ultraviolet light is also used in the purification of ingestible liquids. Highly absorbative fluids such as beer, wine, and vinegar characteristically absorb almost all germicidal energy at their immediate surface.

- **Water purification system.**

The treatment of water via ultraviolet radiation exposure has been accepted by the scientific community as a means to kill disease producing microorganisms. Disease such as cholera and typhoid conditions is prevented by UV treatment. It does not alter the taste or odor of the media due to the absence of chemical infusion (Mathew, 1999).

- **Sterilization of air.**

Can destroy the air borne micro organisms present in air.

2.10.3 Gamma Irradiation

Introduction

Food irradiation is one means of food preservation that may not be familiar to many, but it has been in development since the early decades of the twentieth century. If properly applied irradiation can be an effective way to treat a variety of problems in our food supply, such as insect infestation of grains, sprouting of potatoes, rapid ripening of fruits and bacterial growth (Andress et al., 1998).

Radiation is not a modern man made creation. In the 1980s, radioactive substances and X-rays were discovered. The biggest contribution of man's use of radiation has been in the medical-field, medical and dental X-rays, detection and treatment of diseases, sterilization

of medical equipments, medical devices, pharmaceutical products, and home products, and production of sterilized food for special hospital diets (Johnston and Stevenson, 1990).

However more than 30 countries have approved and are using food irradiation technologies to ensure food safety. Countries utilizing food irradiation for various purposes include Japan, China, the Soviet Union, the Netherlands and France. In the U.S., irradiated foods have been used by astronauts, the military and hospital patients (Diehl, 1990).

History of the Irradiation preservation of foods.

Early in the 1920s, a French scientist discovered that irradiation could be used to preserve food. Irradiation was first patented for food preservation in 1905 by two British Scientists. Food irradiation was first used in the United States in 1921 to inactivate human parasite *Trichinella Spiralis,* which contaminated pork muscle. In the United States food irradiation was approved in 1963 for control of insect in wheat and wheat flour (Canovas et al., 1998).

Definition of irradiation.

Simply food irradiation is a process of exposing foods, either repacked or in bulk, to very high energy, invisible light waves (radiation). Food irradiation is a means of preservation, it is used to extend product shelflife. Food irradiation uses gamma rays, X-rays or electron beams that are part of the invisible light waves range of the electromagnetic spectrum (Andress et al., 1998).

Sources of radiation.

There are three type of energy that can be used for irradiation of food. X-rays, electron beam, and gamma rays. Gamma rays are produced by radioactive substances (called radioisotopes) that continuously emit the high-energy gamma rays. The approved source of gamma rays for food irradiation is cobalt 60 (the most common) and Cesium 137 (Canovas et al., 1998).

Doses and effects of radiation

The dose (amount of KGy) permitted varies according to the type of food and the desired action. Treatment levels have been approved by FDA as follows;

1."Low" doses (up to 1KGy) designed to;

1. control insects in grains.
2. inhibit sprouting in white potatoes.

3. control trichinae in pork.
4. inhibit decay and control insects in fruit and vegetable.

2."Medium" doses (1-10KGy) designed to;

1. control *Salmonella, Shigella, Campylobacter and Yesinia* in meat, poultry and fish.
2. delay mold growth on strawberries and other fruits.

3."High" doses (greater than 10 KGy) designed to;

1. kill microorganisms and insect in spices.
2. commercially sterilize foods, destroying all microorganisms of public health concern.

When radiation energy is absorbed by food, it causes a variety of chemical and physical reactions. The amount of energy the food absorbed is controlled so the changes produced have desirable food preservation effects while maintaining the safety, quality, and wholesomeness of the food. The food itself does not become radioactive.

Labeling of irradiated foods

The regulations required that all produce be labeled at the packing /wholesale and retail levels. At the retail level, the label must bear the symbol (See Fig: 2.2) plus one of these statements. 'treated with radiation' or 'treated by irradiation'. In addition the manufacturer may add a phrase, which truthfully described the primary purpose of the treatment, such as 'treated with radiation to control spoilage'. For irradiated foods sold at the wholesale level, the logo and the wording are still required. In addition, however, they must be accompanied by the caution 'do not irradiate again' (Andress et al., 1998).

Fig.2.2 Radura Label

Safety of irradiated foods

Irradiated food does not become radioactive. At the radiation energy levels used in food processing; only chemical changes are possible, not nuclear changes that would make the food itself radioactive. In 1981 the Food and Agricultural Organization (FAO) of the United Nations, the International Atomic Energy Agency (IAEA), and the World Health Organization concluded that "any food irradiated up to average dose of 1Mrad or less is wholesome for humans and there fore should be approved without further testing" (Johnston and Stevenson, 1990).

Foods Currently Being Irradiated

Internationally, foods such as apples, strawberries, bananas, mangoes, onions, potatoes, spices and seasonings, meat, poultry, fish, frog legs, and grains have been irradiated for many years. In Japan more that 20,000 pounds of potatoes are irradiated each year to prevent sprouting. In the Netherlands more than 18,000 pounds of foods such as strawberries, spices, poultry, dehydrated vegetables, and frozen products are irradiated daily. Belgium irradiates more than 8,000 tons of food per year. Canada has approved the irradiation of potatoes, onions, wheat flour, fish fillets, and spices and seasonings. Today more than 35 countries have approved irradiation of some 40 different food products (Abgrall and Misner, 1998).

In the United States spices and seasonings have been approved by the Food and Drug Administration (FDA) to be irradiated up to 30 kGy to reduce the number of microorganisms and insects. Irradiation of spices and seasonings reduces the dependency for the chemical fumigant methyl bromide. Fruits such as avocados, mangoes, and papayas imported into the United States have been approved by the FDA to receive irradiation treatments us to 1 kGy maximum to control non-native insects such as the Mediterranean fruit fly or Medfly. Potatoes and onions have been approved to receive 0.05 to 0.15 kGy to inhibit sprouting, while a maximum of 1 kGy can be applied to grains, such as wheat and oats, to prevent insect infestation. The advantages of food irradiation are improved product safety and shelf life (Robert and Weese, 2000).

Nutritional Quality of Irradiated Foods

Food proteins, carbohydrates, and fats have been found to be relatively stable to irradiation up to 10 kGy. Minerals have been reported to be stable to irradiation. However, vitamins A, C, E, and B1 (thiamine) tend to be susceptible to irradiation at dosages of 1 kGy or above. These vitamins are also sensitive to heat processing. All of the other vitamins tend to be relatively stable to irradiation up to 5 kGy. Thiamine is one of the most radiation-sensitive vitamins. The percent of vitamins lost in a food product will depend upon the irradiation dose, the food's composition, temperature of the food being irradiated, and the presence or absence of oxygen. Vitamins are more susceptible to irradiation in the presence of oxygen and at temperatures above freezing. Generally, the greater the irradiation dose, the greater the loss of vitamins. A joint committee of FAO, WHO, and IAEA claims that the losses of vitamins in foods heat treated and stored for extended periods of time. Low-dose irradiation does not cause a significant decrease in the nutritional quality of foods (Abgrall and Misner, 1998).

2.11 Market Survey

Marketing survey can be expressed as a systematic gathering and analyzing of data about problems relating to the marketing of goods and services. There are several objectives in a marketing survey. Some of the objectives are to identify the characteristics of the product that demand by the customer and the potential market to identify the possibilities of expanding the market future etc. (Baker, 1993).

CHAPTER 3

MATERIALS AND METHODOLOGY

Experiment 1

3.1 Evaluation of the processing Environment sanitation

3.1.1 Sterilization of noodles processing machine

Materials	Apparatus
Boil water	Noodle processing machine
Chlorine water	Packaging material (LDPE)
Pure alcohol (100%)	Mixing basket

Clean up procedure was carried out to the noodles processing machine and other related equipments (Mixing basket, Spoons, sieve, sauce pan) firstly with dipped in hot water, then chlorine water and finally was wiped in pure alcohol.

3.1.2 Swab method for fresh noodles processing machine

Materials

Cotton wool
Ringer solution
Plate Count Agar (Oxoid)

Apparatus

Test tubes
Petri dishes (Borosil, Diameter 90mm)
Tray of the sheeting machine
Belt of the sheeting machine
Slitter
Mixing basket
Packing material (Low Density Polyethylene)

3.1.2.1 Swab method

Cotton swabs were wiped on the surface area near to 1cm^2 of the fresh noodles processing machine (Belt, sheeter, slitter), packing material and mixing basket. Each swab was put in to the test tube, which contained 10ml ringer solution, closed the tube and labeled. Then 1ml of each solution was inoculated in sterile Plate count agar media and incubated at 37 ^{0}C for 24-48 hrs. After the specified period of incubation, colonies were counted in each petri dish using the colony counter. This swab method was carried out before and after the sterilization of fresh noodles processing machine and other used equipments.

3.1.3 Microbial analysis of tap water (Aerobic plate count, Coliform test)

Materials

Tap water sample
70% alcohol
Distilled water
Standard Method Agar (Oxoid)
Mac Conky broth (Oxoid)
Peptone water

Apparatus

Incubator (Memmert)
Pipette (ISO lab, Germany, 10ml)
Small conical flask (ISO lab, Germany, 250ml)
Conical flask (Borosil, 1000ml)
Measuring cylinder (Borosil, 50ml)
Magnetic stirrer (Biocraft)
Petri dish (Borosil, 90mm)
Cotton wool
Aluminum foil
Electric balance (Libror, AEG-220, Capacity-220.0000g)

3.1.3.1 Preparation of media

Standard Method Agar

23.5g of medium was suspended in 1L of distilled water and boiled to dissolve completely and it was sterilized by autoclaving at 121 ^{0}C for 15 minutes.

Peptone water

5g of peptone and 8.5g of salt was added in to the 1L of distilled water and boiled to dissolve completely. Then it was sterilized by autoclaving at 121 ^{0}C for 15 minutes.

MacConky broth

35 g of sample was suspended in 1L of distilled water and boiled to dissolve completely. Then it was sterilized by autoclaving at 121 ^{0}C for 15 minutes.

3.1.3.2 Preparation of serial dilution:

1ml of original water sample was measured and mixed with 9ml of peptone water and shaked well. It was labeled as 10^{-1} solution also called as first dilution. Second dilution prepared from the first dilution, 1ml was transferred in to second dilution tube containing 9 ml of peptone water. It was labeled as 10^{-2} solution. This was repeated in preparation of 10^{-3}, 10^{-4}, 10^{-5}, and 10^{-6}.

3.1.3.3 Pour plate method (Aerobic plate count) for tap water

The serial dilution solutions were prepared as above. Then 15ml of prepared standard method Agar medium was poured in to sterile Petri dishes. Then 1ml from each water sample of serial dilutions was pippetted out and introduced aseptically in to sterilized Petri dishes. They were labeled as 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6} using a permanent marker.

1ml of original water sample was pippetted out in to the Petri dishes with 15 ml of the standard method Agar medium and it was labeled as 10^{o}. Without the sample only medium was kept as control. Then the dishes were incubated at 36 ^{0}C for 72 hours. After specified period of incubation, colonies were counted in each Petri dish using the colony counter. (SLS 516:Part1, 1991).

3.1.3.4 Coliform test for tap water

For water analysis 15 test tubes were used. MacConky broth was used as the culture medium. 10 ml of MacConky broth was taken to each of 15 test tubes and Durham tubes were introduced to all the tubes and they were sterilized after filling of culture media without air bubbles. After test tubes were covered with cotton plug and Aluminum foil. All test tubes were autoclaved at 121^0C, 15 Psi pressure, and 15 minutes for sterilization.

After that 1ml of original water sample was taken into pipette. It was taken in to 5 separate tubes, which contained 10 ml quantities of MacConky broth with Durham tubes and tubes were labeled as 10^o.

1ml was pipette out from 10^o dilution and introduced in to 5 test tubes of MacConky broth with Durham tubes and labeled as 10^{-1}. After 1ml of 10^{-1} solution was pipetted in to another 5 test tubes with Durham tubes. It was labeled as 10^{-2}.Finally from 10^{-2} solution, 1ml was pipetted out in to remaining 5 test tubes which contained MacConky broth with Durham tubes, and labeled as 10^{-3}.

After each test tube was incubated at 37^0C and examined the gas formation in the Durham tubes after 24 -48 hours. Number of tubes out of each set of 5 were recorded, which gave positive results for the particular organism and was calculated using MPN table (SLS 516: Part 3, 1991). (See.App. XI).

Experiment 2

3.2 Preliminary Study of fresh noodles processing steps

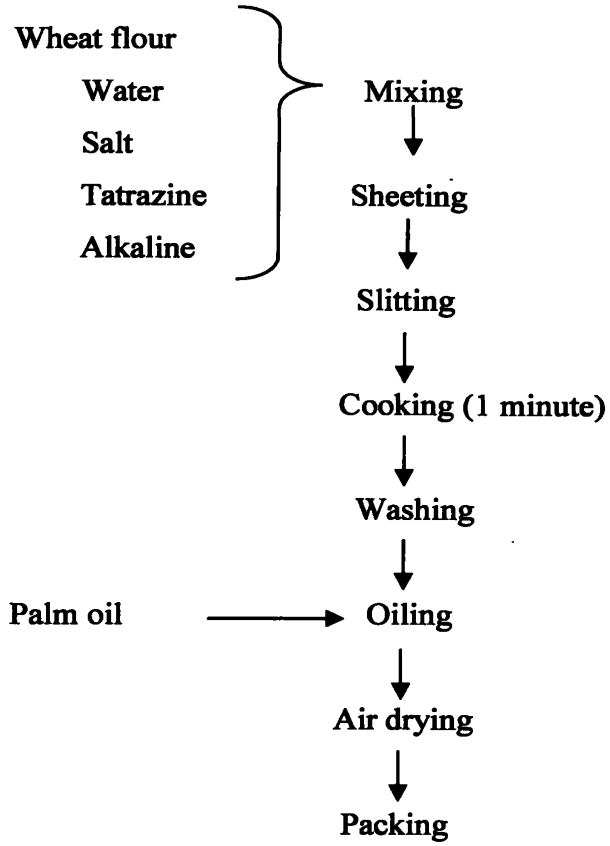


Fig 3.1 Processing flow chart of fresh noodles

Firstly 30g of salt, 0.3g of tatrazine and 3g of NaOH (Sodium hydroxide) were measured and it was dissolved in 310 ml of tap water. Noodle crumb was kneaded by adding mixture of water. Then the noodle dough was sheeted and slitted by using noodles processing machine. Noodles waves were cooked in boiled water about 1 minutes, and washed by using tap water. 15 ml of palm oil was incorporated in it and mixed well. Waves were spread on Air condition room at about 1-2 hours. Then dried noodles were packed.

3.2.1 Effect of different preservatives on extending shelf life.

Materials

Potassium carbonate (0.6%)

Sodium Carbonate (0.4%)

Glycine and acetic acid (0.5% and 0.2%)

Calcium propionate (0.2%)

Potassium sorbate (0.1%)

Acetic acid (0.2%)

Lactic acid (0.2%)

Wheat flour (1kg)

Salt (3%)

Water (31%)

Colouring (Tatrazine) (15ppm)

Palm oil (6%)

Apparatus

Gloves

Mixing basket

Spoons

Sauce pan

Tray

Noodles sheeting machine (Model: LT 19N)

Gas cooker

pH meter (pH Scan WP2, +0.1pH)

Electronic balance (Libror, AEG-220, Capacity-220.0000g)

Sieve(0.01mm)

Microwave oven

3.2.1.1 Modifying the existing procedure

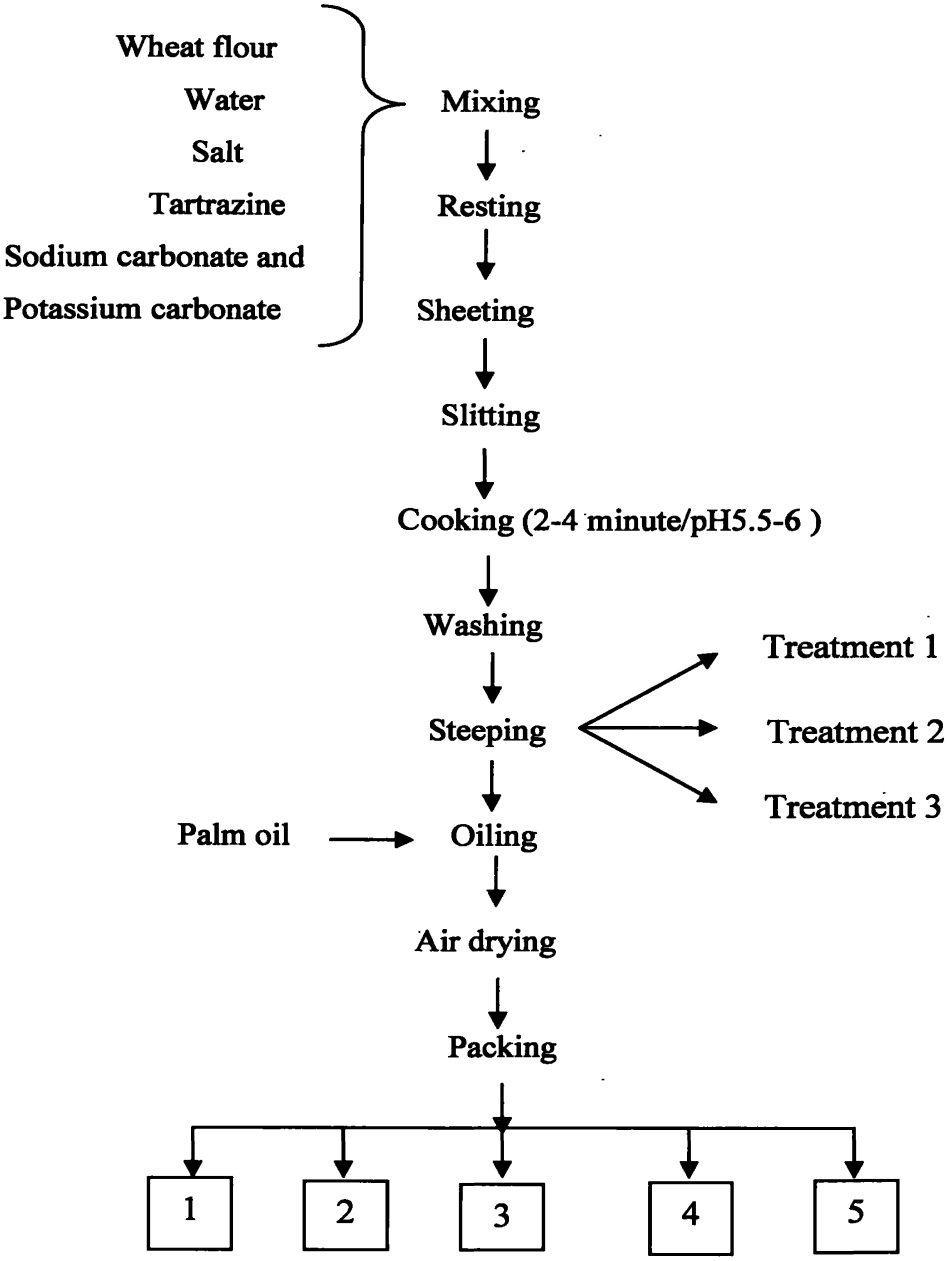


Fig 3.2 Process modification flow chart

The effect of different preservatives alone and in combination was evaluated. Preservatives were added at the steeping process of the noodle processing. 1, 2, 3 treatments were given with ingredients indicated below and packing was done in the following way.

Treatment 1 = Potassium sorbate (1g) and glycine (5g)/L water.

Treatment 2 = Potassium sorbate (1g) and glycine (5g) and acetic (4ml)/L water.

Treatment 3 = Glycine (5g) and acetic (4ml)/L water.

1 = Microwave before seal (Medium high temperature /3minutes)

2 = Seal and microwave (Medium low/3minutes)

3 = Vacuum pack

4 = Vacuum pack and microwave (Medium low/3minutes)

5 = Control (Consider normal fresh noodles processing procedure)

Optimum shelf records were determined by observing visual appearance, colour, texture, odour, surface visible fungi, swelling of the packing during 2 days period. pH, Aerobic plate count was checked within one week period (See App I, II, III for Treatment 1, 2, 3 respectively)

3.2.1.2 Effectiveness of the calcium propionate (Treatment 4)

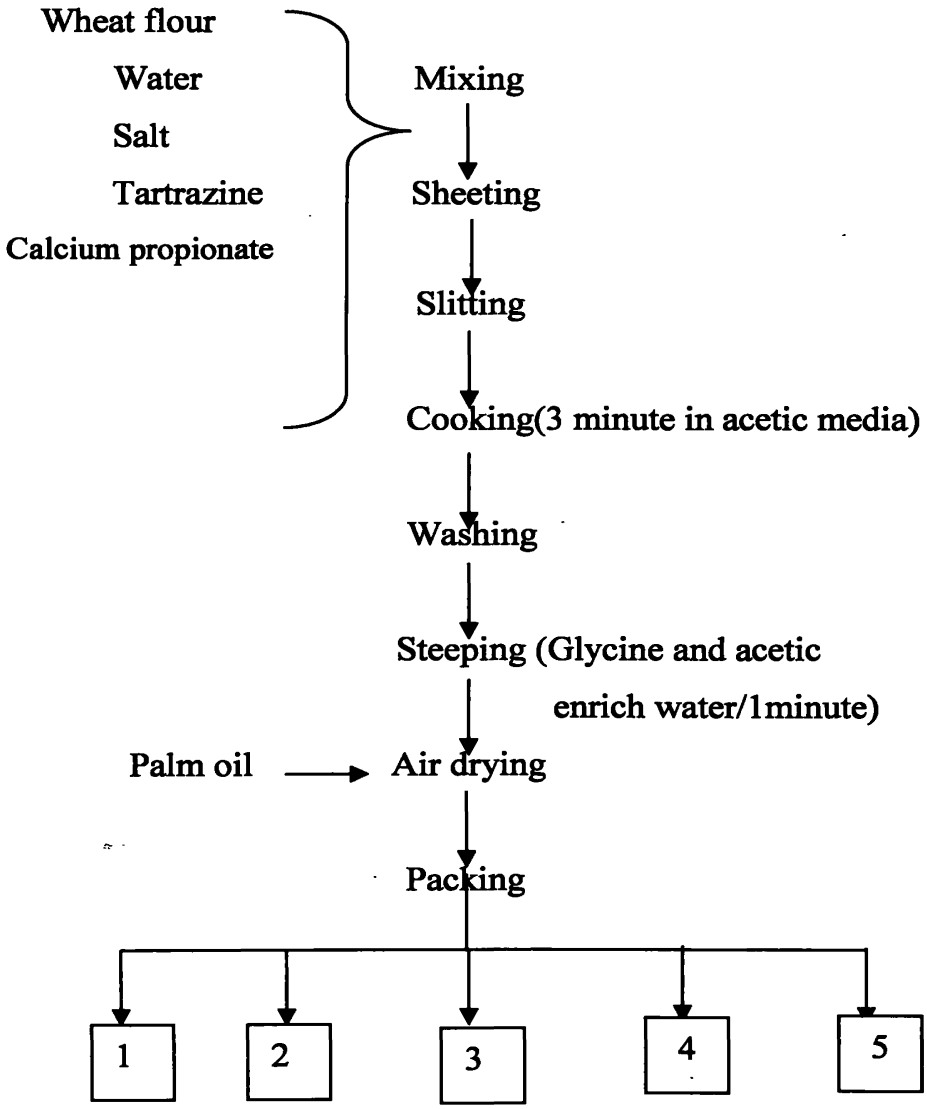


Fig 3.3 Process modification flow chart for Calcium propionate

Another sampling was carried out by using calcium propionate as preservative and steeping step was as glycine, acetic mixture. Packaging was same to the above. Optimum shelf records were determined by observing visual appearance, colour, texture, odour, surface visible fungi, swelling of the packing during 2 days period (See App IV).

3.2.1.3 Effectiveness of the Acetic acid and Lactic acid (Treatment 5)

Also by using acetic acid and Lactic acid as a preservatives sampling were carried out by using mixture of glycine and acetic acid as a steeping step. Optimum shelf records were determined by observing visual appearance, colour, texture, odour, surface visible fungi, swelling of the packing during 2 days period (See App V).

Experiment 3

3.3 Extending the shelf life by irradiation techniques

3.3.1 Evaluation of irradiation effectiveness on fresh noodles

Materials

Fresh noodles samples (200g, 500g, 1kg)

Apparatus

UV Lamp (Wave length 315nm)
Gamma irradiation machine (Gamma Chamber 5000)

3.3.1.1. UV preservation method

Nine packets of 500g fresh noodles samples and 9 packets of 1 kg fresh noodles samples were prepared and UV treated using for the time duration indicated below in Table.3.1

Table: 3.1 UV exposure time

Sample size	Time (minutes)		
	15	30	60
500g	3	3	3
1kg	3	3	3

Optimum shelf life was determined by observing visual appearance, colour, texture, odour, surface visible fungi, swelling of the packing during 4 days period (See App VI).

3.3.1.2 Gamma irradiation method

Fresh noodles packed in bags (100g) were gamma irradiated for different dosage levels. Irradiation dosage and time taken to gain the dosage is indicated in the table. 3.2.

Table: 3.2 Gamma dosage

Dose (KGy)	Time need to gain the dose (minutes)	Amount of samples
0.2	2	15
0.4	4	15
0.6	6	15
0.8	8	10
1	10	10
2	20	10
3	30	10
4	40	8
5	50	5

Optimum shelf life was determine by observing visual appearance, colour, texture, odour, surface visible fungi, swelling of the packing during 2 days period. pH, , coliform, aerobic plate count, yeast and mold count were checked within 1 week . (See.App.VII)

3.3.2 Microbial assessment of 5KGy irradiated sample.

3.3.2.1 Enumeration of yeast and moulds:

Materials

Peptone water

Yeast extract-Dextrose-chloramphenicol Agar medium

Chloromphenicol

Water

Apparatus

Small conical flask (250ml)
Test tubes with screw cap
Petri dish
Incubator
Pipette (ISO lab, Germany, 1ml)
Lamina flow

3.3.2.2 Preparation of media

Peptone water:

1g of peptone powder and 8.5g of salt was suspended in 1L of distilled water and boiled to dissolve completely. Then it was sterilized by autoclaving 121^0C for 15 minutes.

Yeast extract-Dextrose-chloromphenicol Agar medium:

13g of Agar, 20g of Dextrose and 5g yeast was suspended in 1L-distilled water and boiled to dissolve completely. Then it was sterilized by autoclaving at 121^0C for 15 minutes.

3.3.2.3 Preparation of serial dilution:

10g of original fresh noodles sample was measured and mixed with 90ml of peptone water and shaked well. It was labeled as 10^{-1} solution also called as first dilution. Second dilution prepared from the first dilution, 1ml was transferred in to second dilution tube containing 9 ml of peptone water. It was labeled as 10^{-2} solution. This was repeated in preparation of 10^{-3}, 10^{-4}, 10^{-5}, and 10^{-6} dilution series.

The serial dilution solutions were prepared as above. Then 2-3 drops of chloromphenicol was added to the prepared medium and it was poured in to Petri dishes. Then 1ml from each fresh noodle sample of serial dilutions was pippetted out and introduced aseptically in to sterilized Petri dishes. It was labeled as 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6} dilutions.

1ml of original sample was pippetted out in to the Petri dishes with 15 ml of the medium and it was labeled as 10^{o}. Without the sample only medium was kept as control. Then the dishes

were incubated at 36^{0}C for 72 hours. After specified period of incubation, colonies were counted in each Petri dish using the colony counter. (SLS 516: Part 2, 1991).

3.3.2.4 Coliform test

Materials

70% alcohol
Distilled water
Standard Method Agar (Oxoid)
Mac Conky broth (Oxoid)
Peptone water

Apparatus:

Incubator (Memmert)
Pipette (ISO lab, Germany, 10ml)
Small conical flask (ISO lab, Germany, 250ml)
Conical flask (Borosil, 1000ml)
Measuring cylinder (Borosil, 50ml)
Magnetic stirrer (Biocraft)
Petri dish (Borosil ,90mm)
Cotton wool
Aluminum foil
Electric balance (Libror, AEG-220, Capacity-220.0000g)

Preparation of MacConkey broth

35 g of Mac Conkey broth media was measured using electronic balance and it was added to the conical flask. Then 500ml of distilled water was added to it and mixed well. After that culture media was filled in to the test tubes. Then open ends of the test tubes have been closed using cotton wool and aluminum foil. After that test tubes were sterilized using autoclave at 121^{0}C about 20 minutes under the pressure of 15 Psi.

This test is called '9 test tubes'. MacConky broth was used as the culture medium. 10 ml of MacConky broth were put in to each 9 test tubes and Durham tubes were introduced to all the tubes and they were sterilized after filling of culture media without air bubbles. After test tubes were covered with cotton plug and Aluminum foil. All test tubes were autoclave at 121^{0}C, 15 Psi pressure, and 15 minutes for sterilization.

After that 1g of fresh noodles sample was measured and it was dissolved in 99ml distilled water. 1ml was put in to 3 separate tubes, which contained 10 ml quantities of MacConky broth with Durham tubes and the tubes were labeled as 10^{o} dilution.

1ml was pipette out from 10^{o} dilutions and introduced in to 3 test tubes of MacConky broth with Durham tubes and labeled as 10^{-1}. After 1ml of 10^{-1} solution was pipette in to another 3 test tubes with Durham tubes it was labeled as 10^{-2}. Finally from 10^{-2} solution, 1ml was pipette out in to remaining 3 test tubes which contained MacConky broth with Durham tubes, and labeled as 10^{-3} dilution.

After each test tube was incubated at 37^{0}C and examined the gas formation in the Durham tubes after 24 -48 hours. Number of tubes out of each set of 3 were recorded, which gave positive results for the particular organism and was calculated using MPN table (SLS 516: Part 3, 1991). (See.App.XI).

3.3.2.5 Total plate count

The distribution serial of 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} solutions were prepaired as above. Then 1ml of inoculums from 10^{-3}, of serial dilutions were pipetted out and introduced aseptically into sterilized petridishes. Then within 15 ml of the prepared standard method agar was poured in to the petridishes. After that petridishes were closed immediately and mixed shaking clockwise and anty clockwise for even distribution of media on plates. After that petridishes were allow to set. Finally Petri dishes were inverted and kept them in an Incubator at 30 ± 1^{0}C for 48 ± 2hr. After incubation period dishes were taken out from the incubator and colonies were counted in each petridish using the colony counter (SLS 516: part1, 1991).
In this method following equation was used to calculate the number of microorganisms per milliter or per gram of the product, using the following equation;

Number of microbial cells per ml = Number of colonies* dilution factor
Colonies per plate = X
Dilution factor = 10^{y}
Volume of dilution added to the plate = 1ml
Thus,

microbial count = $X*10^{y}$ cells/1ml

3.4 Physicochemical Analysis of sample

3.4.1 Determination of pH

Materials

Fresh noodles sample
Distilled water

Apparatus

Mortar and Pestle
Filter paper (Watman)
Measuring cylinder (Brosil, Capacity 100ml±0.2ml, Ex 20^0C)
pH meter (pH Scan WP2, +-0.1pH)

1g of fresh noodles sample was weighed and crushed using motar and pestal. Crushed sample was mixed thoroughly with 100 ml of distilled water and strained through a filter paper (Watman). pH of the sample was directly taken by inserting the calibrated pH meter to the filtrate.

3.5 Proximate analysis

3.5.1 Moisture content

Materials

Fresh noodles sample

Apparatus

Electronic balance (MS-100, Capacity 2g-100g,100mg)
Porcelain core
Oven
Dessicator

Methodology

The metal dish was dried in the oven from 30 minutes and cooled in desiccators and weighed to the nearest milligram (m_1). 10g of fresh noodle sample with metal dish was

weighed (m_2). Sample was dried for 2 hours at 105^{0}C in an oven. Then cooled in desiccators and weighed (m_3). The process of drying, cooling and weighing was repeated at 30 minutes intervals until the difference between two successive weighing is not exceed 1mg (see App.VIII).

$$\text{Moisture, \% by mass} = \frac{(m_3-m_1)\times 100}{(m_2-m_1)}$$

3.5.2 Protein content determination by kjeldhal method

Materials

Fresh noodle sample
Concentrated Sulphuric acid (Con.H_2SO_4)
Selenium tablet (Catalyst)
Distilled water
30% NaOH
4% Boric acid
Mix Indicator (Bromocresol green and methyl red)
0.02N HCl

Apparatus

Electric balance
Petri dish (Borosil)
Kjeldhal Digestion unit
Kjeldhal tube
Measuring cylinder (Borosil, 100ml)
Volumetric flask (50 ml)
Distillation unit
Titration flask
Burette (10 ml)
Metal stand
White porcelain piece

Methodology

0.6g of food sample was weighed in to kjeldhal flask accurately. 25 ml of concentration H_2SO_4 and 2g of catalyst was added to it. It was digested in kjeldhal digestion

unit until clean solution was observed (12 hours). Then it was cooled and diluted in to the 100ml with distilled water. 5ml portion of above solution was added distillation part and 10 ml of NaOH solution was added to it. At the same time steam was passed through it. The liberated ammonia was collected in to the flask which contain boric acid and methyl red and bromo cresol green mix indicator. After finishing all the air bubbles distilled, take that sample and it was titrated with 0.02N HCl solution until the end point become from blue color to colorless or light pink color. The blank test was carried out using same procedure without the sample (see App. IX).

3.5.3 Total ash content

Materials

Fresh noodle sample

Apparatus

Electric balance
Porcelain core
Muffle furnace
Dessicator

The crucible was weighed (m_1) and a noodle sample was weighed (m_2). Sample with crucible was kept in a fume cupboard until no more black gas is evolved. Then sample was kept in the muffle furnace and was ignited at 600^0C until grey ash obtained. The crucible was cooled in a desiccator and weighed (m_3). This process was repeated until the difference between two successive weighing is were not exceed 1mg (see App. X).

$$\text{Total ash, \% mass} = \frac{(m_3-m_1)}{m_2} \times 100$$

3.6 Materials for Market Research

Market research questionare

3.6.1 Preliminary market research

- Market research was conducted to investigate the customer's perception on fresh noodles.
- The objectives in Ceylon Agro Industry (Pvt) Ltd regarding fresh noodle were identified by having discussions with the executive team,
- According to the objective target population was selected.
- To facilitate direct face to face interview on questionare was prepared with 12 questions (See.Appe.XII).
- The marketing survey was conducted. As general public is the target 60 randomly selected buyers of noodles were interviewed selecting 30 from seeduwa area 30 from Badulla area.
- Data were descriptively analyzed.

CHAPTER 4

RESULTS AND DISCUSSION

Experiment 1

4.1 Evaluation of the processing environment sanitation

4.1.1 Swab method for fresh noodles processing machine

Sterilization of processing equipments with hot water, chlorine water and pure alcohol shows positive result in reducing microbial count Table (4.1).

Table 4.1 Bacteriological count (Count/cm^2)

Sample description	Before Sterilization	After Sterilization
Tray of the sheeting machine	12	1
Belt of the sheeting machine	19	10
Slitter	13	5
Mixing basket	15	4
Packing material	5	Nil

According to Marriott, 2001 hot water can denature some of protein molecules in the microbial cell. Also when chlorine mixed with water, they hydrolyzed to form hypochlorous acid, which will dissociate in water to form a hydrogen ions (H^+) and hypochlorite (OCl^-). These compounds have ability to break chemical bonds, leading to the formation of smaller more soluble molecules and an increase in cleaning speed and efficacy (Marriott, 2001).

Alcohols may weaken the cell wall and alter the microbial cell envelope by changing the capsule, cell wall, cell membrane, or surface motility structures. The cell wall of microbes is essential for the life of most bacterial and fungal cells. Microbial death usually follows the development of holes in the cell membrane by ethyl alcohol. Alcohols exert their action by denaturing proteins and dissolving lipids. In tinctures, they enhance the effectiveness of other antimicrobial chemicals (Rollins, 2004).

4.1.2 Microbiology Evaluation in tap water

Tap water is directly added to the noodles dough, hence evaluation of its microbial growth is essential inorder to extend the shelf life of fresh noodles.

Table 4.2 Microbial Evaluation of tap water

Test	Amount
Aerobic Plate Count	52 per ml
Coliform	Nil per 100ml
Escherichia coli	Nil per 100ml

No significance microbial count is observed on water and water is free from pathogenic organisms such as *Coliform spp* Table (4.2). It is essential that fresh/hokkien noodles are manufactured under clean and hygiene conditions. The process required good house keeping and sanitary practices (Dick, 1996).

Experiment 2

4.2 Preliminary study of fresh noodles processing steps

Ingredients are mixing with water to form the alkaline dough. Sodium hydroxide (NaOH) is used as an alkaline solution. But use of this is illegal in some countries. If the level of NaOH (0.3%) is too high, adequate gluten development does not occur, and noodles eating quality become much less elastic (Karim, 1990).

Mixing result in the formation of crumbly dough with small and uniform particle sizes. Gluten development in noodles dough during mixing is minimized. After the crumbly dough is passing through a pair of sheeting rolls to form a noodle dough sheet. Noodle slitting is done by a cutting machine, which is equipped with a pair of calibration rolls, a slitter and a cutter or a waver (Dick, 1996).

Hokkien noodles are usually parboiled for 45-90 seconds to achieve 80%-90% gelatinization in starch. The noodles are then coated with 1-2% edible vegetable oil to prevent the strands from sticking together (Dick, 1996).

Oil coated noodles strands were spread on the Air Condition room for 2-3 hours to reduce the moisture content to some extent. Then strands were packed in low density poly ethylene bags.

4.2.1 Effect of different preservatives on extending shelf life

Table 4.3 Shelf life (Days) at ambient temperature

Sample	Shelf life, Days			
	Treatment 1	Treatment2	Treatment3	Treatment4
Micro wave before sealing	6	6	6	8
Seal and Micro wave	6	6	6	8
Vacuum pack	5	4	4	3
Vacuum pack and Micro wave	9	8	17	10

According to the results obtained optimum shelf record was significantly appeared in vacuum packed and micro waved samples than the others. Among the experiments carried out as Vacuum pack and microwave in treatment 3 shows remarkable increase in their shelf life Major difference is the mixture of steeping step which was carried out. It was glycine and acetic mixture.

Most processed noodles, which have a high water activity (a_w> 0.98) are not stored under refrigerator. Control sample was began to swell within 24-48 hours. The unique quality of yellow noodles is due to the inclusion of alkaline salts, often known as kansui or lye water. The main component of the kansui is sodium carbonate and potassium carbonate gave high alkaline and preservative effect than the NaOH. Yellowness and brightness of noodles is affected by kansui, also by bran specks, specific flour proteins, proteases and polyphenol oxidases, level of damage starch, flour particle size, added bleaching agents or color (Dick, 1996).

Cooking time and the acidity of the medium is very important for inhibit the growth of pathogenic microorganisms. Potassium sorbate and Calcium propionates have high preservative effect at the low pH, Therefore pH adjusted to 5-5.6 by adding acetic acid while boiling the raw noodles.

According to the Dick, 1996 Glycine with acetic mixture gave strong preservative effect against bacteria, molds and yeast than other combinations. Also it acts as a coating to the noodles wave and gave protection against pathogens to enter.

The high speed motion of water molecules from microwave exposure generates heat which if evenly dispersed throughout a food, may reduce some microbe growth. Micro wave radiation in E.coli and Bacillus subtilis cell suspensions resulted in a dramatic reduction of the viable counts as well as increase in the amount of DNA and protein released from the cells according to the increase of the final temperature of the cell suspensions. Most of the bacterial cells inactivated by microwave radiation remain unlysed. Leakage of the cell materials caused by microwave processing. Micro wave injured cells often been reported to release ninhydrin-positive material, purines, and pyrimidines in to a suspension (Woo et al., 2000).

Any packaging system that reduces oxygen level called as vacuum package. It offers advantages that extend the shelf life and improve quality retention but it also increases many microbiological concerns. The anaerobic environment (no oxygen) prevent the growth of typical spoilage organisms that need oxygen to grow and that are responsible for off odors, slim and texture changes. It also reduces oxidation of the foods, retards rancidity and color deterioration (Padilla and Zakaur, 2001).

Therefore it is evident that combination of vacuum packing and micro wave can reduced the microbial load drastically helping extension of shelf life of fresh noodles at ambient conditions.

Table 4.4 Shelf life of the treatment 5 at ambient temperature

Sample	Shelf life (Days)
Acetic acid	3
Lactic acid	5

Until the gas formation inside the package there is no fungi formation in the lactic acid contains fresh noodles. It's given strong preservative effect against yeast and molds than bacteria. But acetic acid hasn't much more effectiveness against yeast and molds.

Experiment 3

4.3 Radiation preservation

4.3.1 UV preservation

Optimum shelf life was given in table 4.5 which was exposed to UV light.

Table 4.5 Optimum shelf life of the UV treatment method

Sample size	Shelf life (Days)		
	15 minutes	30 minutes	60 minutes
500g	5	8	11
1kg	4	6	8

500g, 30 minutes exposure Packet was lasted 11 days without any changes. But others show fungal formation within 8 days of storage. Swelling was not observed. To extend the shelf life of the product, UV light is gave biggest contribution to the modern food sector. Based on the experiments which compared the effectiveness of various light sources on the survival ratio of different species of bacteria, scientist were able to determine the wavelength of UV light which produced maximum germicidal effectiveness. This wavelength was determined to be 253.7nm/254nm, also important the intensity and exposure time. Ultraviolet (UV) radiation, a form of nonionizing radiation, has a low degree of penetration and causes cell damage by making thymine dimers in DNA that interfere with DNA replication (Rollins,2004).

Short wavelength of UV light causes adjacent thymine molecules on DNA to dimerize and resultant thymine dimmer is very stable. If exposure time high more thymine dimmers are formed in the DNA.Then enough of these defects accumulate on a microorganisms DNA its replication is inhibited. So cellular process is disrupted due to the DNA damage, the cell cannot carry out its normal functions properly. If the damage is extensive and widespread the cell will die.

Above experiment was carried out under the wave length of 315 nm, which were not in the germicidal level, because of that the products were not shown long shelf records.

4.3.2 Gamma preservation

Results revealed that the optimum shelf life is given by 5KGy treated sample, while other treatment gives a shorter shelf life Table (4.6).

Table 4.6 Optimum shelf life of the gamma treated method

Dose (KGy)	Shelf life (Days)
0	2
0.2	3
0.4	3
0.6	4
0.8	4
1	5
2	6
3	7
4	10
5	34

The effects of radiation depend on its wavelength, intensity, and duration. Irradiation of food is refers to the process by which the food has enough radiation energy to cause ionization. Ionizing radiation (gamma rays) has a high degree of penetration and exerts its effect primarily by ionizing water and forming highly reactive hydroxyl radicals, Ionization can lead to the death of the microorganisms due to genetic damage, which prevents cellular replication (Rollins, 2004).

4.3.3 Physicochemical analysis in 5KGy sample

4.3.3.1 Determination of pH

pH variation within shelf life period was minimum.

4.3.4 Microbial Evaluation in 5KGy sample

4.3.4.1 Coliform Test

After 24hrs, and 48 hrs observations were done to determine the presence of Coliform. There was no gas formation in Durham tubes inserted in the test tube, which were kept in the incubator. It was confirmed that the product does not contain any coliforms. Presence of coliform indicates the poor sanitation condition.

4.3.4.2 Total plate Count (Aerobic plate count)

After 24 hrs of incubation, there were number of colonies appeared in the Petri dishes of Standard Method Agar. All the colonies were counted in the Petri dishes and TPC was counted according to the SLS Standards.

4.3.4.3 Yeast and molds

After 24-48 hrs incubation, number of colonies was counted.

Table 4.7 Microbial count (cfu/g)

Weeks	Coliform	TPC	Yeast and molds	pH
1	Nil	34*10	2*10	6.01
2	Nil	$12*10^2$	$1*10^2$	6.03
3	Nil	$39*10^2$	$2*10^3$	6.00
4	Nil	$7*10^3$	$45*10^3$	5.96
5	Not detected	$26*10^4$	$10*10^4$	5.87

End of the 5^{th} week the fresh noodles packet was initiated to swell. So optimum shelf record of the 5KGy was 34 days. According to the SLS Standards for the pre cooked product yeast and mould should be less than 10^4 and TPC should be less than 10^6 for microbiologically accepted product. During the shelf life of there these requirements are fulfilled. Also the product is free of pathogenic micro organisms are free. Thus it is safe for the consumption.

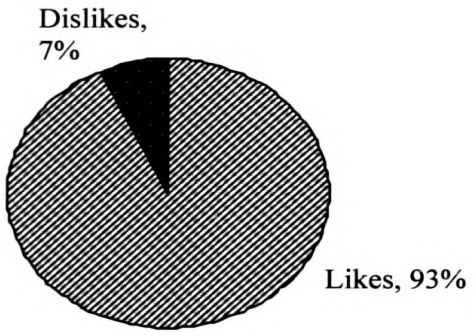
4.4 Proximate Analysis

Table 4.8 Proximte analysis

Total ash, % mass	1.16
Protein, % mass	9.041
Moisture, % mass	43.09

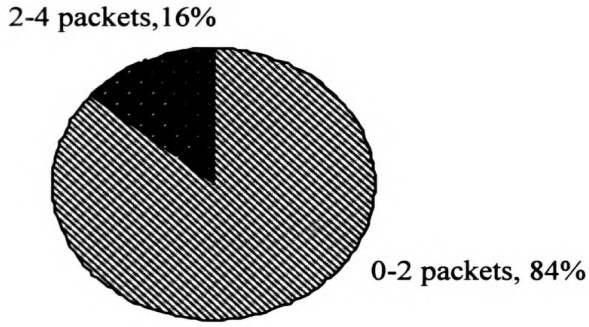
4.5 Finding of the Market Survey

4.5.1 Preference of the consumers for consuming noodles



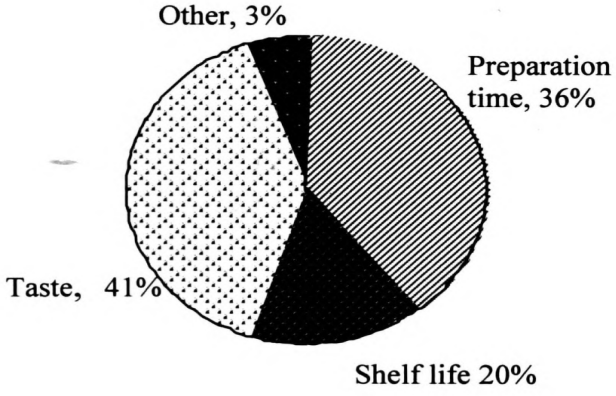
About 93% of the consumers liked to eat noodles and about 7 % of the consumers do not like to eat noodles. So there is a big market for noodles.

4.5.2 Purchase per week



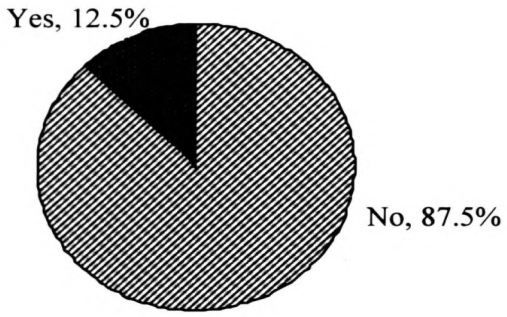
According to the chart most people buy 0-2 packets per week.

4.5.3 Factors considered when buying noodles



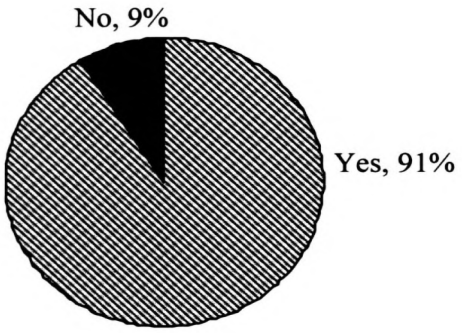
The people considered mostly about the taste of the noodles. Second most important factor is the time of preparation, also number of people consider about the shelf life too.

4.5.4 Experience about fresh noodles



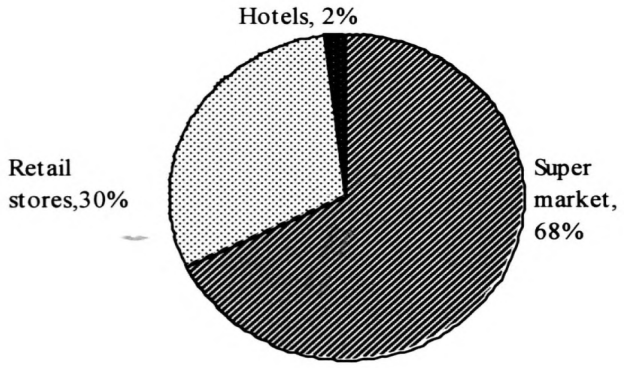
Most of the people do not have experience about fresh noodles.

4.5.5 Trend to buy fresh noodles



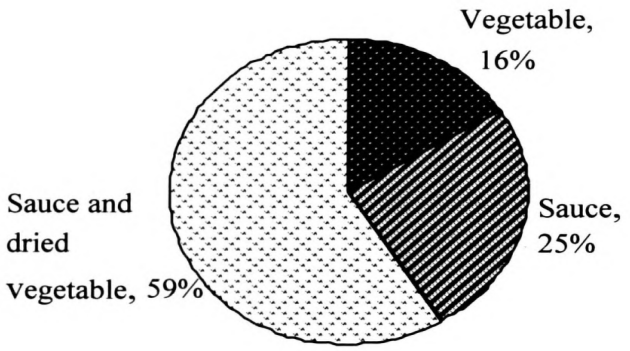
91% of the people like to purchase fresh noodles, if they are in the market. 9% of the people do not like to buy. So there is a potential market for fresh noodles.

4.5.6 Purchase place



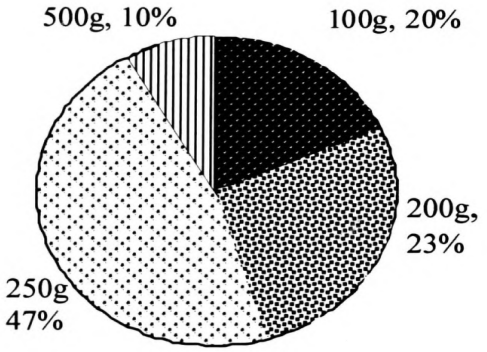
Most of the people (68%) like to purchase fresh noodles from super markets. Some of them are like to purchase from Retail stores. Few of them are like to purchase from hotels. So when doing sales priority should give for the super markets.

4.5.7 Ingredients used for enriching the taste



Most of the people (59%) like to taste the fresh noodles with sauce and dried vegetable, 25% of them like to taste with only sauce, and 16% are with vegetable only. So it is better to add pack of sauce and dried vegetable to fresh noodle packet.

4.5.8 Consumer consideration about the quantity



Majority of the people (47%) like to purchase 250g packets of fresh noodles. 23% of the people like to purchase 200g and 20% wish to buy 100g packets. Few of them like to buy 500g packets. So it is better to market the 250g packets.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

After considering the observation and results from beginning to end of the research period, the final conclusion can express as follows.

1. Preservatives along with microwave and vacuum package can extending the shelf life of fresh noodles up to 17 days.
2. Gamma irradiation technique is very useful for extend the shelf life of fresh noodle up to 34 days under ambient temperature.
3. Preliminary market survey revealed that there is a potential market for fresh noodles, so it is useful to extend the shelf life of the fresh noodles.
4. UV treatment was not successful,because the used wave length was not in the germicidal level (254nm).

5.2 Recommendation

1 It is better to use fresh noodles processing line to avoid the contaminations cause by manual operations.

2 It is better to treate the fresh noodles sample under 254nm UV lamp and find the optimum shelf life records.

3 To further increase the shelf life of fresh noodles it is better to expose it to gamma rays with a dosage under dosage greater than 5KGy and less than 10 KGy.

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Appendix-I

Very good-1
Good -2
Satisfactory-3
Unsatisfactory-4
Bad -5

Date	Sample Number	Appearance	Colour	Odour	Texture	Swelling	pH	TPC (cfu/g)
4/19	1-1	1	1	1	1	No	6.1	2×10^3
	1-2	1	1	1	1	No	6.02	2.3×10^3
	1-3	1	1	1	1	No	6.04	3×10^4
	1-4	1	1	1	1	No	6.01	1.4×10^2
	1-5	1	1	1	1	No	5.99	4.9×10^4
4/21	1-1	1	1	1	1	No		
	1-2	1	1	1	1	No		
	1-3	2	1	2	2	No		
	1-4	1	1	1	1	No		
	1-5	3	3	3	3	Yes		
4/23	1-1	2	1	2	2	No		
	1-2	2	1	2	2	No		
	1-3	3	2	3	3	No		
	1-4	1	1	2	2	No		
	1-5	4	4	4	4	Yes		
4/25	1-1	3	2	3	3	No		
	1-2	3	3	3	3	No		
	1-3	4	4	4	4	Yes		
	1-4	2	2	2	2	No		
	1-5							
4/26	1-1	4	4	5	5	Yes		
	1-2	3	3	4	4	Yes		
	1-3	5	5	5	5	Yes		
	1-4	2	2	3	3	No		
	1-5							
4/27	1-4	2	2	3	3	No	5.98	2.3×10^4
4/28	1-4	3	3	4	4	Yes		

Appendix-II

Very good-1
Good -2
Satisfactory-3
Unsatisfactory-4
Bad -5

Date	Sample Number	Appearance	Colour	Odour	Texture	Swelling	Surface visible fungai	pH	TPC (cfu/g)
4/19	2-1	1	1	1	1	No	No	6.1	
	2-2	1	1	1	1	No	No	6.04	
	2-3	1	1	1	1	No	No	6.15	
	2-4	1	1	1	1	No	No	6	
	2-5	1	1	1	1	No	No	5.9	
4/21	2-1	1	1	1	1	No	No		
	2-2	1	1	1	1	No	No		
	2-3	1	1	1	1	No	No		
	2-4	1	1	1	1	No	No		
	2-5	3	3	3	3	Yes	Yes		
4/23	2-1	2	2	1	1	No	No		
	2-2	2	2	1	1	No	No		
	2-3	3	3	3	3	No	No		
	2-4	1	1	1	2	No	No		
	2-5								
4/25	2-1	3	3	2	2	No	No		
	2-2	3	3	2	2	No	No		
	2-3	4	4	4	4	Yes	Yes		
	2-4	2	2	2	3	No	No		
	2-5								
4/27	2-1	4	4	4	4	Yes	Yes		
	2-2	4	4	4	4	Yes	Yes		
	2-3								
	2-4	3	3	3	3	No	No		
4/28	2-4	3	3	3	3	Yes	No		

Appendix-III

Very good-1
Good -2
Satisfactory-3
Unsatisfactory-4
Bad -5

Date	Sample Number	Appearance	Colour	Odour	Texture	Swelling	Surface visible fungi	pH	TPC (cfu/g)
4/20	3-1	1	1	1	1	No	No	5.98	1.7×10^3
	3-2	1	1	1	1	No	No	5.99	2×10^3
	3-3	1	1	1	1	No	No	6.01	3×10^4
	3-4	1	1	1	1	No	No	5.89	1.2×10^2
	3-5	1	1	1	1	No	No	6.1	4.1×10^4
4/22	3-1	1	1	1	1	No	No		
	3-2	1	1	1	1	No	No		
	3-3	1	1	1	1	No	No		
	3-4	1	1	1	1	No	No		
	3-5	3	3	3	3	Yes	Yes		
4/24	3-1	1	1	2	2	No	No		
	3-2	1	1	2	2	No	No		
	3-3	2	2	2	2	No	No		
	3-4	1	1	1	1	No	No		
	3-5	4	4	4	4	No	No		
4/26	3-1	3	3	2	2	No	No		
	3-2	3	3	2	2	No	No		
	3-3	4	4	4	4	Yes	Yes		
	3-4	1	1	1	1	No	No		
	3-5								
4/28	3-1	4	4	3	3	Yes	Yes		
	3-2	4	4	3	3	Yes	Yes		
	3-3								
	3-4	1	1	2	2	No	No	5.71	5.2×10^3
	3-5								
5/2	3-1								
	3-2								
	3-3								
	3-4	2	2	3	3	No	No		
	3-5								
5/4	3-4	2	2	3	3	No	No		
5/6	3-4	3	3	3	3	No	No	5.4	8×10^5
5/8	3-4	3	3	3	4	Yes	Yes		

Appendix-IV

Very good-1
Good -2
Satisfactory-3
Unsatisfactory-4
Bad -5

Date	Sample Number	Appearance	Colour	Odour	Texture	Swelling	Surface visible fungi	pH	TPC (cfu/g)
5/29	4-1	1	1	1	1	No	No		
	4-2	1	1	1	1	No	No		
	4-3	1	1	1	1	No	No		
	4-4	1	1	1	1	No	No		
	4-5	1	1	1	1	No	No		
6/1	4-1	2	2	2	1	No	No		
	4-2	2	2	2	2	No	No		
	4-3	3	3	4	3	Yes	No		
	4-4	1	1	1	1	No	No		
	4-5	4	4	4	4	Yes	Yes		
6/5	4-1	3	3	3	3	No	No		
	4-2	2	2	3	3	No	No		
	4-3	4	4	4	4	No	No		
	4-4	2	2	1	1	No	No		
	4-5								
6/7	4-1	3	3	4	4	Yes	No		
	4-2	3	3	4	4	Yes	No		
	4-3	4	4	4	4	Yes	Yes		
	4-4	3	3	3	2	No	No		
	4-5								
6/9	4-1								
	4-2								
	4-3								
	4-4	3	3	4	3	Yes	No		

Appendix-V

Very good-1
Good -2
Satisfactory-3
Unsatisfactory-4
Bad -5

Date	Sample Number	Appearance	Colour	Odour	Texture	Swelling	Surface visible fungi	pH	TPC (cfu/g)
6/5	A	1	1	1	1	No	No		
	L	1	1	1	1	No	No		
6/8	A	1	1	1	1	No	No		
	L	1	1	1	1	No	No		
6/10	A	2	2	3	3	No	No		
	L	1	1	1	1	No	No		
6/12	A	2	2	3	3	Yes	Yes		
	L	2	2	2	2	No	No		
6/15	A								
	L	2	2	3	3	Yes	No		

A-Acetic acid
L-Lactic acid

Appendix-VI

Very good-1
Good -2
Satisfactory-3
Unsatisfactory-4
Bad -5

Date	Sample(Kg)	Time	Appearance	Colour	Odour	Texture	Swelling	Surface visible fungi
6/23	0.5	15	1	1	1	1	No	No
		30	1	1	1	1	No	No
		60	1	1	1	1	No	No
	1	15	1	1	1	1	No	No
		30	1	1	1	1	No	No
		60	1	1	1	1	No	No
6/26	0.5	15	1	1	2	2	No	No
		30	1	1	1	1	No	No
		60	1	1	1	1	No	No
	1	15	2	2	3	3	No	No
		30	1	1	2	2	No	No
		60	1	1	1	1	No	No
6/28	0.5	15	3	3	4	4	No	Yes
		30	2	1	2	2	No	No
		60	1	1	1	1	No	No
	1	15	4	4	4	4	No	Yes
		30	3	3	3	3	No	No
		60						
6/30	0.5	30	3	3	4	4	No	Yes
		60	2	2	1	1	No	No
	1	30	4	4	5	4	No	Yes
		60	3	3	2	2	No	No
7/3	0.5	60	4	4	4	3	No	Yes
	1	60	5	5	4	4	No	Yes

Appendix-VII

Very good-1
Good -2
Satisfactory-3
Unsatisfactory-4
Bad -5

Date	Dose (KGy)	Appearance	Colour	Odour	Texture	Swelling	Surface visible fungi
6/17	2	1	1	1	1	No	No
	3	1	1	1	1	No	No
	4	1	1	1	1	No	No
	5	1	1	1	1	No	No
6/20	2	3	3	2	2	No	No
	3	2	2	2	2	No	No
	4	2	2	2	2	No	No
	5	1	1	1	1	No	No
6/23	2	4	4	3	3	Yes	No
	3	3	3	2	2	No	No
	4	2	2	3	3	No	No
	5	1	1	1	1	No	No
6/26	3						
	4	3	3	3	3	No	No
	5	1	1	1	1	No	No
6/28	4	4	4	4	4	Yes	No
	5	1	2	1	1	No	No
7/3	5	2	2	2	2	No	No
7/8	5	2	2	2	2	No	No
7/10	5	2	2	2	2	No	No
7/13	5	2	2	3	3	No	No
7/15	5	2	2	3	3	No	No
7/18	5	3	3	3	3	No	No
7/21	5	3	3	3	3	Yes	No

Appendix-VIII

6.1. Moisture, percent by mass $= \frac{(m_3-m_1)}{(m_2-m_1)} \times 100$

$= \frac{83.166-78.857}{10} \times 100$

$= 43.09\%$

m_1 -Weight of the crucible

m_2 -weight of the sample with crucible

m_3 -Wight of the oven dried sample with the crucible

Appendix-IX

6.2. Protein, percent by mass

$$\text{Nitrogen percentage} = \frac{(V_1-V_2) * M.HCl * 14 * V * 100\%}{A * W}$$

$$\text{Nitrogen percentage} = \frac{(1.9-0.35) \times 0.02 \times 14 \times 100 \times 100}{5 \times 0.6 \times 1000}$$

$$\text{Protein percentage} = 1.44 \times 6.25$$

V_1= Titrate volume of fresh noodles

V_2= Titrate volume of fresh noodles

M.HCl=Molarlity of the HCl

V=Volume of the aliquate diluted

A=Aliquate of the sample

W=Weight of the sample

Appendix-X

6.3. Total ash, % mass $= \dfrac{(m_3-m_1) \times 100}{(m_2 - m_1)}$

$= \dfrac{(13.258-13.200) \times 100}{5}$

m_1 -Weight of the porcelain dish
m_2 -weight of the sample with porcelain dish
m_3 -Wight of the ash with the porcelain dish

Appendix-XI

Appendix

MPN TABLE

Number of positive tubes for the three dilution factors retained			MPN	Confidence limits 99%		95%	
0	0	0	0.3				
0	1	0	0.3	0.1	2.3	0.1	1.7
1	0	0	0.4	0.1	2.8	0.1	2.1
1	0	1	0.7	0.1	3.5	0.2	2.7
0	1	1	0.7	0.1	3.6	0.2	2.8
1	2	0	1.1	0.2	4.4	0.4	3.5
2	0	0	0.9	0.1	5.0	0.2	3.8
2	0	1	1.4	0.3	6.2	0.5	4.8
2	1	0	1.5	0.3	6.5	0.5	5.0
2	1	1	2.0	0.5	7.7	0.8	6.1
2	2	0	2.1	0.5	0.8	0.8	6.3
3	0	0	2.3	0.4	17.7	0.7	12.9
3	0	1	4	1	25	1	18
3	1	0	4	1	29	2	21
3	1	1	7	2	37	2	28
3	2	0	9	2	52	3	39
3	2	1	15	3	66	5	51
3	2	2	21	5	82	8	64
3	3	0	20	10	190	10	140
3	3	1	50	10	320	20	240
3	3	1	110	20	640	30	480
3	3	3	>110				

Results not shown in the table cannot be used; such results may be expected in only 5 per cent of cases.

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Appendix-XII

Market survey questionere for general public:

1). Do you consume noodles?
a. Yes b. No

2). How many packets do you consume per week?
a. 0-2 b.2-4 c. 4-6 d. Over 6

3). What is the favorite noodle type you would like to buy?
a. Instant pack b. Bulk

c. Fresh

4).What is the reason?

a. Reduce the preparation time b. Long shelf life
c. Taste d. other

5). Have you any experience regarding the fresh noodles?
a. Yes b. No

6). If fresh noodles are available in our local market would you like to buy it?
a. Yes b. No

7). Where would you like to buy it?

a. Super market b. Retail stores c. Other

8).With what would you like to taste it?

a. Dried vegetable packet b. Sauce packet

c. Sauce and dried vegetable

8). what quantity you would prefer to buy?
a. 100g b. 200g c. 250g d. 500g

9). How much money intended to spend for your choice
a. Rs 20-25 b.Rs 25-30 c .Rs 30-35 d.Rs 35-40

10). Age range/Years
a. 10-20 b. 20-35 c. 35-50 d. Over 50

11). Salary scale
a. Below RS.10 000 b. Rs.10 000-20000

c. Rs 20 000-30 000 d. Above 30 000

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