بسم الله الرحمن الرحيم

Sudan University of Science and Technology

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Impact of Cooking and Additives on the Chemical and Microbiological Characteristics of Indomie Noodles

أثر الطبخ والمواد المضافة على الخصائص الكيميائية والميكروبيولوجية للإندومي

Dissertation Submitted to Sudan University of Science and Technology in Partial Fulfillment for the Requirements of the Degree of Master of Science in Food Science and Technology

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الآية

قال تعالى:-

(فَلْيَنْظُرِ الْإِنْسَانُ إِلَى طَعَامِهِ ﴿24﴾ أَنَّا صَبَبْنَا الْمَاءَ صَبًّا ﴿25﴾ ثُمَّ شَقَقْنَا الْأَرْضَ
شَقًّا ﴿26﴾ فَأَنْبَتْنَا فِيهَا حَبًّا ﴿27﴾ وَعِنَبًا وَقَضْبًا ﴿28﴾ وَزَيْتُونًا وَنَخْلًا
﴿29﴾ وَحَدَائِقَ غُلْبًا ﴿30﴾ وَفَاكِهَةً وَأَبًّا ﴿31﴾ مَتَاعًا لَكُمْ وَلِأَنْعَامِكُمْ
﴿32﴾)

صدق الله العظيم

سورة عبس الآيات (24-32)

Dedication

To my father.

To my mother.

To my brothers.

To my sisters & my friends.

Acknowledgement

Thanks at the beginning and at last for Almighty **ALLAH** who gave me strength to complete this study. I am deeply indebted to my supervisor **Prof. Dr. Ahmed Elawad Elfaki** for his continual encouragement and help throughout this work. Thanks also extended for all others who help me in finishing this work.

Abstract

The main goal of this study was to determine the effect of cooking and added materials (spices and monosodium glutamate) on the chemical and microbial characteristics of two types of indomie noodles (chicken and vegetable flavoured) . The samples were the products of Sawabash factory (Soba industrial area).

The samples were analyzed before and after the cooking at 100^{o}C for 20 minutes. The obtained results of the chemical analysis of vegetable flavoured and chicken flavoured indomie before cooking were as follows: moisture content (5.38, 4.45%) ash content (0.83, 0.69%) crude protein (8.71, 8.83%) crude fibre (0.42, 0.37%) fat content (0.34, 0.30%) carbohydrates content (84.32, 85.36%) and energy content was (375.20, 379.50 kcal). While the results after cooking were (40.84, 39.89%) (5.86, 8.31%) (2.59, 2.55%) (0.23, 0.18%) (0.43, 0.53%) (50.04, 48.54%) and (214.40, 209.10 kcal), respectively.

The results of mineral content before cooking showed that sodium was (23.54, 23.49mg/100g) potassium (220.90, 215.20 mg/100g) and phosphorus (209.50, 208.00 mg/100g) . While those after cooking were (5.60, 6.58 mg/100g) (76.03, 86.90 mg/100g) and (57.39,66.71 mg/100g), respectively.

On the other hand the results of the microbial analysis showed that, both of vegetable flavoured and chicken flavoured indomie were free from total coliforms, yeasts, moulds and *salmonella* ,however the chicken flavoured indomie was found to contain total count of bacteria (6.5 $\log_{10}$ cfu/g) and *Staphylococcus aureus*(5.5 $\log_{10}$ cfu/g).

The results showed no monosodium glutamate in both of chicken flavoured and vegetables flavoured indomie before cooking, While those after cooking were (3.57 and 0.00 mg/100g) respectively.

From these results, the chicken flavoured indomie contains pathogenic bacteria (*Staphylococcus aureus*) and monosodium glutamate .However, cooking process reduced the chemical composition in both types of indomie

الملخص

الهدف الأساسي من هذه الدراسة هو تحديد تأثير الطبخ والمواد المضافة (التوابل وأحادي جلوتومات الصوديوم) على الخصائص الكيميائية والميكروبية لنوعين من الإندومي (نكهة الدجاج ونكهة الخضار). العينات هي منتجات مصنع ساواباش (المنطقة الصناعية سوبا والخرطوم بحري). حُللت العينات قبل وبعد الطبخ عند 100 درجة مئوية لمدة 20 دقيقه. النتائج المتحصل عليها من التحليل الكيميائي للإندومي بنكهة الخضار والإندومي بنكهة الدجاج قبل الطبخ كانت كالتالي:محتوى الرطوبة (5.38 ,4.45%) , محتوى الرماد (0.83، 0.69,%) ، البروتين (8.71 ,8.83%), الألياف(0.42, 0.37 %), الدهون (0.34 , 0.30%), محتوى الكربوهيدرات (85.36, 84.32 %) , ومحتوى الطاقة كان (375.20 ,379.50 كيلو سعر حراري)على التوالي. بينما كانت النتائج بعد عملية الطبخ (39.89,40.84 %) , (5.86 , 8.31 %) ,(2.59 , 2.55 %) , (0.23 , 0.18%), (0.43 , 0.53%), (50.04 , 48.54 %) و (214.40 ,209.10 كيلو سعر حراري) على التوالي.

نتائج محتوى المعادن قبل الطبخ أظهرت أن محتوى الصوديوم (23.54 , 23.49 ملجم لكل 100جرام) , البوتاسيوم (220.90 , 215.20 ملجم لكل 100جرام) والفسفور (209.50 , 208.00 ملجم لكل 100جرام) . بينما كانت بعد الطبخ (5.60, 6.58 ملجم لكل 100جرام), (86.90,76.03 ملجم لكل 100جرام) و(66.71,57.39 ملجم لكل100 جرام). ومن جهة أخرى أظهرت نتائج التحليل الميكروبي أن كلا النوعين من الإندومي كانت خاليه من الكوليفورم والخمائروالأعفان والسالمونيلا ,ومع ذلك وجد في الإندومي بنكهة الدجاج محتوى العد الكلي للبكتريا(6.50 $\log_{10}$ cfu/g)

و *staphylococcus aureus* (5.50 $\log_{10}$ cfu/g).

كما أظهرت النتائج عدم وجود أحادي جلوتومات الصوديوم في كل من الإندومي بنكهة الدجاج والإندومي بنكهة الخضار قبل الطبخ. بينما كانت النتائج بعد الطبخ (3.27 ,0.00 ملجم لكل 100جرام) على التوالي.

من هذه النتائج نجد أن الاندومي بنكهة الدجاج يحتوي على بكتريا ممرضه (***Staphylococcus aureus***) وأحادي جلوتامات الصوديوم . كذلك نجد أن عملية الطبخ قد قللت التركيب الكيميائي في كلا النوعين من الاندومي .

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CHAPTER ONE

INTRODUCTION

Indomie noodles are the world largest instant noodle produced by Indofood-the world largest manufacturer of dried instant noodle in Indonesia. It is sold throughout Indonesia, Malaysia, Australia, Nigeria, Sudan, the United States, and among other numerous countries. Indomie noodle is very nutritious, easy to make and can be eaten both as snacks, as well as, a major meal. It is very versatile and this make it attracts the preferably of majority of people both at work, in school and at home. Indofood is one the largest pre-packaged food companies founded in 1972 in Indonesia (Witular, 2004).

Wheat flour noodles are staple foods in many Asian countries. Historically, noodles were originated from Northern China and subsequently introduced to other Asian countries by traders, seafarers and migrants. Noodles have now become more widely adopted for everyday use and its storage has been facilitated by the introduction of dried noodles. Technological innovation has also been applied to enhance noodles quality and adaptation to meet up with consumer demands and also to increase the taste of boiled noodles. Instant noodles known as staple food in lack some nutritional components such as dietary intake fiber in appropriate proportion therefore incorporation of lentil on noodles gives additional properties like increase in fiber content and indirectly contributes to protein and mineral content. Noodles are widely consumed throughout the world and their global consumption is second only to bread; it is a fast growing sector of the pasta industry. This is because instant noodles are convenient, easy to cook, low cost and have relatively long shelf-life. Wheat flour which is usually used to make instant noodles is not only low in fibre and protein content but also poor in essential amino acid; lysine. Flour of hard wheat (*Tritium aestivuml*) is the main primary ingredient and the addition of alkaline salts can help strengthen the structure and hence improve the firmness of the final product (Hou, and Kruk 1998). However, indomie noodles are made from wheat flour and come in a variety of brands and flavours of seasoning powder. Issues of health concern have been raised against all Indomie noodles brands especially in terms of nutritional value because of its high content of carbohydrates, sodium and fat (in the oil seasoning) without additional ingredients like eggs, meat and vegetables thus making it low in dietary fibre and proteins. Indomie noodle and the seasoning soup base likewise contain high measures of monosodium glutamate (MSG). It is a flavor enhancer utilized by indomie noodle producers to make their shrimp flavors and hamburger flavours. MSG can trigger an unfavorably susceptible response in 1 to 2% of the populace. People who are oversensitive to MSG can get consuming sensations, trunk and facial flushing or torment and cerebral pains from it (Liu and He, 2008).

In this research two types of indomie noodles (vegetable flavour and chicken flavour), usually consumed in Sudan were Selected for the study to achieve the following objectives:

General objective:

To study the chemical and microbiological characteristics of indomie noodles.

Specific objectives:

1. To determine the approximate composition of two types of indomie noodles.
2. To determine the amount of monosodium glutamate in indomie noodles.
3. To study the microorganisms present in indomie noodles.
4. To detect the safety of indomie noodles for human health consumption.

CHAPTER TWO

LITERATURE REVIEW

2.1 Noodles origin and history

The word noodle is derived from the German *Nudel* (noodle) and may be related to the Latin word *nodus* (knot). In American English, noodle is a generic term for unleavened dough made from many different types of ingredients. Noodles can be traced back over 6000 years to northern China (Hou, 2001). In 2005, the discovery by Lu. *et al*. (2005) of a pot of thin noodles preserved for 4000 years in Yellow river slit, the oldest noodles yet discovered were found at Qinghai, China. The 4,000-year-old noodles appeared to have been made from millet and suggest that noodles originated in China. During the 13 century, Marco Polo brought the Chinese noodle technology to Europe, where noodles evolved into the past products (Hou, 2001).Noodles disseminated from China and were quickly adopted by other countries of South East Asia: Korea, Philippines, Thailand and Malaysia, and were well established in Japan by the 16th century (Hatcher, 2001). Buckwheat flour, which had been used as a substitute for rice in Japan, was incorporated into buckwheat (soba) noodles by the seventeenth century. A relatively recent event was the development of the automated deep fried instant noodle (ramen style) in Japan In 1957 by Nissin Foods Where they were quickly adopted as a convenience food. By the1970s the instant noodle had migrated successfully to the United States.In1997, it was estimated that 40 billion servings of instant noodles were consumed annually. The manufacture of noodles was revolutionized by the Japanese with the development of power-driven machinery in 1884. At the beginning of the

20th century, the alkaline salt noodle spread gradually throughout Japan by the Chinese immigrants in Yokahama city the first instant noodle, called chicken ramen, and was produced by Nissin Foods of Japan in 1958. Instant noodles became a mainstream food instantly and their consumers are not only in Asia but worldwide. Most noodles today are produced by machine (Fu, 2008).

2.2 International importance of noodles

Noodle products have become a major source of enjoyment and nutrition. In describing these foods it is noted that flours other than wheat flour can be used and that in some cases noodles are made from composite flours. For example, in Thailand, traditionally the most widely consumed styles of noodles are made from rice flour (Ohtsubo, 1998). In Japan buckwheat noodles containing both wheat and buckwheat are popular and in a number of countries a style of translucent noodle is made from bean starch (Singhakul and Jindal, 1990).However, the major ingredient used in manufacture of noodles is wheat flour. The significance of wheat is demonstrated by the extent of utilization in Asian countries. These data show that annually, the total amount of wheat used for noodles in these countries is approximately 70 million tones, representing in excess of 12 percent of total world wheat production (FAO, 2004). Noodles are popular in each of the countries described although total consumption in china is particularly high because of the large population. It is also significant that wheat consumption continues to expand in Asian countries with this trend predicted to continue over coming decades).The consumption of noodles, particularly instant noodles has also been increasing very rapidly in recent years (Oleson, 1998).

2.3 Classification of noodles

Noodles are strands of dough sheet produced primarily by mixing flour, salt and water that are cut to the desired thickness, depending on regional preferences. While wheat flour is the primary ingredient, rice or buckwheat flour are occasionally used. Noodles can be classified based on ingredients, method of manufacture or regional preferences (Nagao, 1996). Although, Asian noodles and pastas look similar in shape, there are key differences between the products in ingredients used, the processes involved and their consumption patterns (Hou, 2001). Pasta is a dried product made from semolina (coarse flour usually milled from durum wheat) and water, and extruded through a metal die under pressure. After cooking, pasta is often eaten with sauces. Asian noodles are characterized by thin strips slit from sheeted dough that has been made from flour (hard and soft wheat), water and salt- common salt or alkaline salt. Noodles are often consumed in soup. Eggs can also be added to each product to give a firmer texture. The basic noodle-making steps involves making a stiff, crumbly dough by hand kneading or slow mixing of the ingredients, dough resting, sheeting, cutting of noodle strands and boiling (or drying) (Hou and Kruk ,1998).Modification of formulation and processing of noodles according to regional eating habits and taste preferences have created many country-specific systems for noodle classification. Noodle nomenclature is thus not systematically classified and wide differences exist between countries. A general classification system is described below.

2.3.1 Based on raw materials

Noodles can be prepared from wheat flour or with other flours like buckwheat, rice and starch noodles from mung bean starch i.e. rice noodle**,** rice vermicelli, bean threads and soba. Wheat flour noodles include Chinese and Japanese type noodles i.e. egg noodles, somen, udon, and instant noodles. There are many varieties in each noodle type, representing different formulation, processing and noodle quality characteristics. Chinese type noodles are generally made from hard wheat flours, characterized by bright creamy white or bright yellow color and firm 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. Noodles containing buckwheat are also called soba, meaning buckwheat noodle. These noodles are typically light brown or grey in color with a unique taste and flavor (Miskelly, 1993).

2.3.2 Based on alkaline salt reagents added

Based on the absence or presence of alkaline salt in the formula, noodles are classified as white (containing salt) noodles or yellow alkaline (containing alkaline salt) noodles. Alkali gives noodles their characteristic yellowness. White salted noodles comprise of Japanese noodles, Chinese raw noodles or dry noodles. Chinese wet noodles, Hokkien noodles, Cantonese noodles, Chuka-men, Thai bamee, and instant noodles come under the yellow alkaline noodle category. The addition of alkaline salts (kansui, a mixture of sodium and potassium carbonates) in Chinese type noodles gives them a yellow color and a firmer more Elastic texture (Hou and Kruk, 1998).

2.3.3 Based on size

According to the width of the noodle strands Japanese noodles are classified into four types i.e. So-men (Very thin, 0.7-1.2 mm wide), Hiya-mughi (Thin, 1.3-1.7 mm wide), Udon (Standard, 1.9-3.8 mm wide) and Hira-men (Flat, 5.0-6.0 mm wide). Since the smaller size noodles usually soften faster in hot water than the larger size, 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. Other noodle types also have their own typical size (Corke and Bhattacharya, 1999).

2.3.4 Based on processing

Hand-made noodles, still available in Asia because of their favorable texture, were prevalent before the automatic noodle machine was invented in the 1950s. Noodle machines are best suited for commercial production. Noodle processing operations include mixing raw materials, dough sheeting, compounding, sheeting/rolling and slitting. This series of unit operations remains constant among countries for all noodle types. None of the approaches discussed above are sufficient to define each noodle type. Therefore, the nomenclature of noodles should incorporate key aspects such as formulation and basic processing to fully describe the nature of each noodle type as stated below.

2.3.4.1 Fresh noodles

Noodle strands coming out of slitting rolls are cut into certain lengths for packaging without any further processing. Typical examples are Chinese raw noodles, udon noodles, chuka-men, Thai bamee, Cantonese noodles and soba noodles. These are often consumed within 24 hours of manufacture due to quick discoloration. Their shelf life can be extended to 3-5 days if stored under refrigeration (Nagao, 1996).

2.3.4.2 Dried noodles

Fresh noodle stands are dried by sunlight or in a controlled chamber. Chinese raw noodles, Cantonese noodles, chuka-men, udon noodles, and soba noodles can be in dried form. Noodle shelf life is dramatically extended, but fragile noodles may have handling Problems (Owen, 2000).

2.3.4.3 Boiled noodles

Fresh noodle strands are either parboiled (90% complete cooking) or fully cooked. This type includes: Chinese wet noodles, hokkien noodles, udon noodles, and soba noodles. After parboiling, Chinese wet noodles and hokkien noodles are rinsed in cold water, drained and coated with 1-2% vegetable oil to prevent sticking. Boiled udon and soba noodles are not coated with oil. Boiled noodles are re-cooked for another 1-2 minutes before serving (Fu, 2008).

2.3.4.4 Steamed noodles

Fresh alkaline noodle strands are steamed in a steamer and softened with water through rinsing or steeping. This type is also called “Yaki-Soba”, and it is often prepared by stir frying for consumption (Miskelly, 1996).

2.3.4.5 Instant noodles

Instant noodles are fried or dried for dehydration after steaming and termed as instant fried noodles or instant dried noodles respectively. Fried instant noodles are widely preferred for their taste but have greater oil content in comparison to dried instant noodles. Instant noodles are easy to prepare and have longer shelf life e.g. indomie instant noodles (Hou *et al.,* 2010).

2.4 Noodle processing

2.4.1 Main ingredients

The main ingredients for in noodles are wheat flour, salt or kansui (alkaline salt mixture of sodium carbonate, potassium carbonate and sodium phosphate) and water. Other ingredients like starch, gums, emulsifiers, stabilizers, antioxidants, coloring and flavorings agents are also added to improve the texture, eating quality and shelf life of instant noodles. Nowadays, noodles are also fortified with protein, minerals and vitamins to improve their nutritional value (Wu *et al.,* 2006). The flour quality requirement for different types of noodles varies widely. Here, we will focus on the functionality of ingredients, unit operations involved, quality criteria for evaluation, recent trends in fortification and current knowledge in relation to instant noodles (Hou *et al.,* 2010).

2.4.2 Basic processing steps

Noodle processing typically comprises mixing raw materials, resting the crumbly dough, sheeting the dough into two dough sheets, compounding the sheets into one, gradually sheeting the dough into a specified thickness, and slitting into noodle strands. For instant noodles preparation, strands are steamed and dehydrated by drying or frying followed by cooling and packaging with the seasonings (Yu and Ngadi, 2004).

2.4.2.1 Mixing

Ingredients other than flour are pre dissolved in water, stored at 20–30◦C while salt water can be prepared separately. Wheat flour and water along with other weighed ingredients are mixed first at high speed and then at low speed, giving a total time of 15–25 minutes in industries while at laboratory scale researchers have used a mixing time of 4 to 5 minutes (Park and Baik, 2004). The mixing time, however, also depends on the type of mixer used. In contrast to bread processing, function of mixing for noodles is to distribute the ingredients uniformly and to hydrate the flour particles. There is little gluten development during the mixing stage in flour having low water absorption capacity. The degree of gluten development, however, is significant in high water absorption dough (>35%) with long mixing time (>15 minutes). Mixers commonly used in the noodle industry include horizontal mixer, the vertical mixer, continuous high-speed mixer, low-speed super mixer, and the vacuum mixer. Mixing is also influenced by the quality of flour, volume of water added, presence or absence and amount of certain ingredients (especially salt and alkaline salt), and temperature and humidity of processing environment. Flour of high protein content and damaged starch tends to produce larger dough crumbs during mixing that may result in uneven hydration (Azudin, 1998). Mixing is usually followed by dough resting. This step allows the crumbly mixture to rest for a period of time to accelerate further hydration of flour particles and to redistribute water in the dough system. Resting improves processing properties and facilitates gluten formation during sheeting. This is achieved by the relaxation of the gluten structure already formed during mixing. At commercial level, resting facility is usually provided between the mixer and the first pair of sheeting rolls. Resting is carried out by mixing dough at very low speed (5–8 rpm) for 10–20 minutes. Mixing at low speed avoids the formation of large dough pieces during resting and also serves feeding of the sheeting rolls in the continuous process. Resting also determines the degree of starch gelatinization during steaming (Wu *et al.,* 1998).

2.4.2.2 Sheeting

After mixing, the crumbly dough is compressed to form continuous dough sheet which is folded or compounded and passed through subsequent rolls. The sheeting process is intended to achieve a smooth dough sheet with desired thickness, and a continuous and uniform gluten matrix in dough sheet. At the sheeting stage, number of passes through rolls, roll diameter, sheeting speed and reduction ratio are the main factors affecting dough sheet characteristics .The thickness of dough sheet is reduced gradually to avoid damage to the surface and gluten structure which is controlled by roll gap settings in a series of smooth rolls. With each successive pass, the roll diameter should decrease gradually so that compression distance and pressure are also reduced. Dough sheets are rested to allow gluten structure relaxation or mellow the gluten and make it more extensible by slow passage on a zigzag conveyor in automated plants (Neelam *et al.*, 2014).

2.4.2.3 Cutting, slitting and waving

The dough sheet is cut into noodle strands of desired width with a slitter. The width and shape of noodle strands are determined by cutting rolls. Noodles can be either square or round in shape according to various slitters used. In case of instant noodle production, noodle strands are continually fed into a traveling net conveyor, which moves slower than the cutting rolls above it. The speed differential between noodle feeding and net traveling results in a unique waving of noodle strands. For instant noodles, the cutting rolls are numbered from18–22. Numbering represents the number of edges on a piece of 30-mm-wide sheet. For example, a number 18 cutting roll has 18 edges that result in a noodle strip width of about 1.7 mm. noodle strands are cut into a desirable length by a cutter (Neelam *et al.,* 2014).

2.4.2.4 Steaming and molding

The cut and wavy noodle strands are conveyed to a steam chamber to cook them by exposing to a temperature of 100◦C for one–five minutes. The degree of cooking during steaming is critical and depends on the original moisture content of noodle; amount, pressure, and temperature of steam; and steaming time. Under steamed noodles will have a hard core and will be difficult to cook properly, whereas over steamed noodles are soft and sticky. Steaming is a key process in the manufacture of instant noodles. A high degree of starch gelatinization is required for the production of hot-air dried instant noodles. Superheated steam at high temperature can be used to partially cook, rapidly drying them, thus, creating an instant noodle without the necessity of frying in oil (Pronyk *et al.,* 2008). Steam cooking of starch–water mixture triggers a number of physicochemical and functional changes in starch granules, such as the loss of granular structure associated with melting of crystallites and underlying helices, and the generation of an amorphous structure (Dhital *et al.,* 2010). The degree of starch gelatinization determines noodle rehydration rate, firmness, and viscoelasticity, and it is mainly controlled by the steaming process. Steaming time is longer for hot-air dried noodles than for deep fried noodles. Excessive swelling of starch on the noodle surface, which causes many processing problems, should be avoided during steaming in instant noodle production. Noodles cooked by steaming are cooled and extended to separate the strands and cut into one serving size. Weight of noodles is regulated by the number of strands produced by cutting rolls and length of strands. Noodles strands are further folded before cutting for the square type products. The cut noodles are placed in molder of square, round, bowl, or cup shape, depending on the desired product shape before moving to the fryer or drier (Neelam *et al.*, 2014).

2.4.2.5 Frying and drying

After steaming and molding, noodle blocks are fed into frying baskets, which are mounted on the traveling chain of a tunnel fryer. The baskets filled with noodle blocks are immersed in hot oil for deep frying. Dehydration of the exterior surface drives water to migrate from the interior to the exterior of the noodle strands. Eventually, some of the water in the noodles is replaced by oil (Dana and Saguy, 2006). Many tiny holes are created during the frying process due to mass transfer, and they serve as channels for water penetration upon rehydration in hot water. The frying temperature and time are usually varied from 140 to160◦C, for 60 to 120 seconds, respectively. The cup noodles are fried at a higher temperature and longer time as compared with the bag type noodles. The frying process should be optimized to obtain fried noodles with good sensory properties, low fat content, and low fat decomposition products. Deep frying of noodle removes moisture, incorporates oil into noodles, gelatinizes starch before the free water is evaporated, and creates both external and internal porous structures in the noodle that facilitates rehydration. Noodles drying can also be done by hot air to produce instant dried noodles. Frying is the preferred method of drying as non- fried instant noodles require a longer cooking time. The lesser fat content in case of instant dried noodle makes them attractive. Elimination of oil in the drying of instant noodles may alleviate health concerns about the fat content and presence of trans-fatty acids from partially hydrogenated and hydrogenated oils while providing the consumer with a convenient and healthy food product. But the acceptance of dried instant noodles is largely dependent on obtaining good textural properties and eating quality (Neelam *et al.,* 2014).

2.4.2.6 Packaging

Frying or drying is followed by cooling the product to room temperature to avoid rapid oxidation and other changes. The cooled noodles are packed into a bag along with a soup base sachet. While for the cup noodles, powdered soup base is sprinkled over the noodles and sealed with shrink film. Seasonings and dehydrated vegetables are included in soup base. Higher fat content makes the noodles susceptible to oxidative changes and development of rancid flavor. Thus, proper packaging plays important role in extending the shelf life of the product. The onset of rancidity can be delayed by addition of antioxidant in the frying medium. The rancidity of instant noodles is also accelerated in the presence of ultraviolet light; hence, noodles are essentially packaged in reddish yellow or green packaging material without any transparent parts. The packaging material used for noodles are polypropylene or polyethylene film for bag noodles and polyester for cup noodles (Neelam *et al.,* 2014).

2.5 Nutritional composition of noodles

The basic raw material for making noodles is flour. Therefore, its main nutrients are basically the same as flour, including protein, carbohydrates, minerals, and low fat. Taking the ordinary fine dried noodles found in the market for example, 100 g fine dried noodles contain 10.3 g protein, 75.6 g carbohydrates, just 0.6 g fat, 129 mg potassium, 18.45 mg sodium, 11.8 mg selenium, and so on. Instant noodles known as staple food in Malaysia lack some nutritional components such as dietary intake fiber in appropriate proportion, therefore incorporation of lentil on noodles gives additional properties like increase in fiber content and indirectly contributes to protein and mineral content. Noodles are widely consumed throughout the world and their global consumption is second only to bread; it is a fast growing sector of the pasta industry. This is because instant noodles are convenient, easy to cook, low cost and have relatively long shelf-life. Wheat flour which is usually used to make instant noodles is not only low in fiber and protein content but also poor in essential amino acid; lysine. Flour of hard wheat (*Triticum aestivuml*) is the main primary ingredient (Fu, 2008). The chemical composition of incorporated noodles utters the information such as, moisture 8.43%, total carbohydrate 68.30%, crude protein 14.29%, crude fat 4.98%, crude fiber 4.02%, ash 1.54% and calcium 498 mg/100 g which reveals it's a good source of nutrients (Pakhare , 2016).

And the addition of alkaline salts can help strengthen the structure and hence improve the firmness of the final product (Hou and Kruk; 1998). Dry regular instant noodles provide mainly carbohydrates and some proteins, while instant fried noodles also have some fats. Therefore, their Nutritional quality may be improved by fortification with certain amino acids, or by addition of meat or egg and vegetables or soluble fiber (Malkki, 2000). Generally, research on noodles making are based on their quality of product which is produced from wheat flour since it may vary widely on its protein content (Habernicht *et al.*, 2002). Most of noodles are made from flours containing 8–10%protein and 0.36 – 0.4% ash. Noodles and other pasta types are rich in carbohydrate but they are deficient in terms of protein quantity and amino acid balance (Eyidemir and Hayta; 2009)**.** Proximate composition of wheat flour noodles Parameter Amount: Moisture 5.13%, Protein 13.24 %, Fat 15.52%, Total carbohydrate 47%,Crude fiber 1.56%, Calcium 180ppm, Iron 2.78ppm, Ash 1.8% (Ranganna ,1986).

2.6 Microbiology of noodles

The reduction in microbial load after cooking noodles which suggested that control of fungal toxin production can occur by the adjustment of pH, water activity, and temperature control .Temperature however does not protect from all toxin molds, since many will grow at refrigeration temperatures. It was found that several toxin species are capable of growth and toxin production takes place at temperatures as low as10^0 C There is evidence that some strains may be more toxin at low temperatures than at optimum growth temperatures. Proper cooking of noodles, its seasonings and chili is the best means of controlling growth of microorganisms in foods (ICMSF, 2006)

Gram positive bacteria were found to dominate all brands of noodles during spoilage. This is supported by previous studies that associated spoilage of cereals with Gram positive bacteria (Brian *et al.,* 1981). Staphylococcus and Bacillus species were isolated from all the noodles examined, and were found to persist till the 36^{th} hour. These two genera have been implicated previously as among the bacteria that contaminate cereal products. Gram negative bacteria were not isolated from noodles. Gram positive bacteria increasing with time while Gram negative bacteria decreased in noodles of cooked rice. Since college students consume the largest amount of instant noodles among other convenience. (Waduwawara and Manage, 2009).

2.7 Instant noodles

Instant noodles are made from wheat flour, starch, water, salt or kansui (an alkaline salt mixture of sodium carbonate, potassium carbonate and sodium phosphate), and other ingredients that improve the texture and flavor of noodles, partially cooked by steaming and further cooked and dehydrated by a deep frying process (Kim, 1996). Pasta and noodles, both are wheat-based products but they differ depending on the country of origin, raw materials, formula ingredients, manufacturing procedure as well as their consumption patterns (Hou and Kruk 1998; Hou 2001). Pasta products are made from coarse semolina milled from durum wheat (*Triticum durum)* which is mixed with water and then extruded through a metal die under pressure. However, the noodles are prepared using wheat flour of either hard or soft wheat (*Triticum aestivum)* along with water, salt and alkaline salts (Kansui). Noodle manufacturing involves sheeting and cutting of dough which allows lower water addition as compared to other bakery products (Miskelly, 1993). The properties of instant noodles like taste, nutrition, convenience, safety, longer shelf-life and reasonable price have made them popular worldwide. Instant noodles are also used as space and emergency food (Corke and Bhattacharya, 1999).

2.7.1 Instant noodle consumption and production

Instant noodles are consumed in more than 80 countries and have become internationally recognized food. Noodle industry supplies 95.4 billion servings annually to consumers throughout the world and the demands are on the rise. Worldwide, China ranks first in the consumption of noodles followed by Indonesia, Japan and Vietnam according to the world instant noodle association (WINA, 2011).

2.7. 2 Types of instant noodles

Instant noodles are classified into two types on the basis of methods used for the removal of moisture, i.e., instant dried noodles and instant fried noodles. Instant dried noodles are produced in a fully automatic production line similar to the type used for steamed and deep-fried noodles, except that a continuous drying chamber replaces the deep fryer, using hot air as the drying medium. Frying the noodles in oil decreases the moisture content of noodles to about 2–5%, whereas in hot air dried noodles, it is about 8–12%. The heating during frying or hot air drying further gelatinizes the starch and the noodles attain a porous texture, which facilitates rehydration process while cooking the product. Frying is the preferred method of drying and more than 80% of instant noodles are fried because hot air drying results in uneven drying that adversely affects the texture of the finished noodles, requires a longer cooking time, and lacks the distinctive flavor introduced by deep frying. The disadvantage of frying, however, is that fried noodles contain about15–20% oil (compared with a maximum of 3% fat in hot air-dried noodles), are more susceptible to oxidation resulting in rancidity, and have health issues due to higher fat content. The use of antioxidants, however, prolongs the shelf life of fried instant noodles (WINA, 2011). Instant noodles based on their commercially packaged form available are bag type and the cup type noodles. Bag type noodles are available with the sachet of seasonings packed within and usually cooked in constantly boiling water for about three–four minutes before serving. Cup noodles are instant noodles in a waterproof polystyrene cup with the seasoning sprinkled over the noodles and are ready to serve after pouring hot water into the bowl and resting for two–three minutes. The basic processing for bag and cup type noodles is similar. There do exist, however, some differences in the processing of these two types of noodles. For example, the noodle strands of cup noodles are usually thinner to facilitate the rehydration rate, starch is usually included in the formulation, and they are fried for a longer time as compared with bag type counterparts (Kim, 1996).

2.7.3 Quality criteria of instant noodle

Quality factors important for instant noodles are color, flavor, texture, cooking quality, rehydration rates during final preparation, and the presence or absence of rancid taste after extended storage. Sensory evaluation of noodles is carried out to judge the quality and acceptability of the final product. Quality parameters for noodle quality like texture and color assessed using instrumental analysis correlates well with sensory evaluation results and are valuable research tools well suited for monitoring noodle texture after changes in formulations, raw materials, and processing (Hatcher *et al.,* 2008).

2.7.4 Recent trends in nutritional improvement fortification of instant noodles

Instant noodles are fortified either by the fortification of flour used to make noodles by addition of gluten, other flours, such as soya, buckwheat, oats, barley, and legumes flour, or by fortifying the seasoning consumed along with the noodles. Micronutrients, including vitamin A, B1, B2, niacin, folic acid, iron, and iodine, can be added after considering their stability during processing and recommended daily values. Calcium carbonate and gluten are also added to improve the nutritional properties of instant noodles. Fortification of instant noodles with vitamin A, B1, B2, niacin, B6, folic acid, iron, and casein (milk protein) was initiated in 1994 in Indonesia. However, fortification is not mandated by government regulations. Currently, about 80% of instant noodles produced in countries like Philippines are fortified voluntarily. Fortifying the seasoning rather than the flour has an advantage that the fortificants are not exposed to heat and moisture during noodle processing. In addition, the fortificants are better protected being packed in a sachet (Chen *et al*., 2011).

It is relatively simple to add fortificants but ensuring the stability of nutrients in seasoning mixture throughout the shelf life of instant noodles is a major concern. Thiamin stability affected by formulation, processing, and storage has been reported by Bui and Small (2008) in noodles, and it was inferred that potential to use thiamin in noodles where alkaline salts are used is limited due to its instability at higher pH . Hau Fung Cheung *et al.* (2009) investigated folic acid stability in fortified instant noodles by use of capillary electrophoresis and reversed-phase HPLC and reported that it was stable during mixing, sheeting, steaming, and frying of instant fried noodle. Bui and

Small (2007) also evaluated the effectiveness of noodles as potential vehicles for fortification with folic acid. Differing patterns of retention was observed in different type of noodles with similar overall losses of slightly more than 40% for all types. Significant losses occurred for instant noodles during steaming and deep frying of the noodle strands and during subsequent cooking in case of dried noodles. However, it was concluded that fortifying noodles provides an effective means for enhancing folate intake. Khetarpaul and Goyal (2007) reported that protein content and quality can be improved in noodles by incorporation of soy, sorghum, maize, and rice at 10% level without significantly affecting the overall acceptability of the product. Chen *et al*. (2011) investigated the effect of particle size and addition level of wheat bran on quality of dry white Chinese noodles (DWCN) and reported that hardness, gumminess, chewiness and overall acceptability score of cooked noodles decreased, while adhesiveness increased with higher bran content and bran particle size. It was also concluded that 5-10% bran can be satisfactorily incorporated to prepare fiber-rich DWCN. Substitution of 10% oat flour in noodle formulation gave satisfactory results in terms of overall acceptability of the product. Higher levels of oat flour substitution in noodles improved the protein, fat, ash and minerals, however, negatively affected the cooking quality and sensory properties (Aydin and Gocmen, 2011).

Sudha *et al*. (2011) investigated that inclusion of defatted soy flour (DSF) and whey protein concentrate (WPC) in instant vermicelli not only enhanced their protein content and in vitro protein digestibility but also reduced the fat uptake in noodles. Efforts are underway to improve the formulation, extend the shelf life and promote universal fortification of instant noodles. Accordingly, many researchers are exploring the potential of instant noodle fortification as an effective public health intervention and improve its nutritional properties, while manufacturers voluntarily fortify their products.

2.8 Indomie noodles

Indomie is the world largest instant noodle produced and consumed in large quantities worldwide. It is sold throughout Indonesia, Malaysia, Australia, Nigeria, United States of America, and other countries. Indomie noodle is very nutritious, easy to make and can be eaten as snacks and major meal (Sanni *et al*., 2013). It is very versatile and this make it attracts the majority of people both at work, in school, and at home. Because of its versatility, there is an increase rate of consumption among children and young adults. Over the past 17 years, Indomie has made an impact in the Nigerian market with the different brands appealing to several people as well as becoming a household name across countries. It has been estimated that one in two Nigerians have tasted indomie noodles and that up to 15million people eat them regularly (Sanni *et al*., 2013). Indomie noodles is usually prepared for consumption using its spices, therefore, the rate at which indomie noodles is consumed is proportional to the rate at which the spices, is consumed. The major constituents of indomie noodle are wheat flour, vegetable oil, iodized salt, sodium polyphosphate, sodium carbonate, potassium carbonate, guar gum and tartrazine while that of the spices powder are iodized salt, monosodium glutamate (MSG), hydrolyzed vegetable protein, soy powder ,garlic powder ,chicken flavor and chili powder (Sanni *et al*., 2013).

2.9 Monosodium glutamate (MSG)

Monosodium glutamate (Azinomoto) is a well known food additive used throughout the world. This flavor enhancer, not very long ago, was isolated in the laboratory, is called monosodium glutamate (MSG). At a later stage this flavor gained immense popularity worldwide. Since then it has been in use, widely in restaurants (particularly mixed in noodles, soups etc.), packaged food industries (e g. instant meals) and household kitchens. Modern commercial MSG is produced by fermentation of starch, sugar, beet, sugarcane or molasses (Walker and Lupien, 2000).

Around the world monosodium glutamate is used habitually, it adds flavor to the canned chicken broth, packs of onion, sauces, soup mix, cheese and the low-fat yoghurts. It does not enhance the four basic tastes (bitter, salty, sour, and sweet) but it does enhance the complex flavors of meat, poultry, seafood, and vegetables by elevating the taste buds with a flavor Known as UMAMI, which is experienced as a meat or broth like taste (Moskin, 2008).

Monosodium glutamate is an excite toxin, which basically means, a chemical substance that excites your neurons and may cause death. It may aggravate many neurological disorders such as Alzheimer's and Parkinson's disease. MSG side effects may include seizures, brain cell damage, allergies, rashes, asthma attacks, headaches and brain tumors (Blaylock, 1996).

In some recently conducted studies, the most frequently reported symptoms were headache, numbness/tingling, flushing, muscle tightness and generalized weakness. Prevalence of these symptoms are suggested to be 1– 2 % of the general population (Geha *et al.,* 2000).

The monosodium glutamate dosage that produced reactions in human being ranged from 0.5 g to 2.5 g. The optimal palatability concentration for MSG is between 0.2 – 0.8% (w/w) and its use tends to be self-limiting as over-use decreases its palatability (Loliger, 2000). According to a joint inquiry by the governments of Australia and New Zealand in 2003, a typical Chinese restaurant meal contains between10 and 1500 mg of MSG per 100 g (Freeman, 2006).

The largest palatable dose for humans is about 15.000–18.000 mg/kg body weight (Walker, and Lupien, 2000).

Monosodium glutamate has been reported to have caused various health hazard, including gastrointestinal tract disorder (Eweka and Om'Iniabohs; 2007).

As one of the most abundant amino acids, glutamate is present virtually in all foods, with highest levels in protein-rich foods. Glutamate may be present in a bound form, as a component of proteins and peptides or as free glutamate. Levels of free glutamate in foods of animal origin are generally quite low (e.g. beef 33 mg/100 g, cows' milk 2 mg/100 g). Higher levels are seen in vegetables (30-200 mg/100 g) and in spices, sauces and restaurant meals (FSANZ, 2003; Rhodes *et al.*, 1991).

2.10 Nutritional value of indomie noodles

Indomie noodles are very popular as a fast food for both the young and adults. It is well balanced with reasonable metabolizable energy, digestible protein and good aroma during and after cooking. Indomie waste is a by-product obtained from the production of indomie produced .They constitute the broken particles that drop off during the production process and are usually milled before discarding by the company. It contains wheat flour, vegetable oil, iodized salt, sodium polyphosphate, sodium carbonate, guar gum, tartraizine, Cl 19140 and tertiary butyl hydroquinone antioxidant. Tertiary butyl hydroquinone (TBHQ) was developed for stabilizing various vegetable oils, fats and foods against oxidative deterioration, thus extending the storage life of foods. Indomie waste is a suitable energy source containing 3464 metabolizable energy kcal/kg, 94.7% dry matter, 8.75% crude protein, 1.5% crude fiber, 16.35% fat and 13.6% ash (Adeyemi, 2008).

2.11 Specifications and standards of indomie noodles

The specifications and standards for indomie noodles (SNI 01-3551-2000) are shown in Table (1) and(2) and (3) .

Table (1): Chemical composition of indomie noodles (INS):

Item	Specification
Moisture content	Using frying process: 10.0% w/w; Using drying process:14.5% w/w
Protein content	Wheat noodles: Min 8.0% w/w; Other noodles: Min 4.0% w/w
Ash content (without salt)	Max 2% W/W

* INS = Indonesian National Standard

Table (2): Usage Levels of MSG in indomie noodles (INS):

Item	Specification
powder for indomie noodles	10–17%

Table (3): Microbiology of indomie noodles (INS):

Item	Specification
Total Plate Count	< 1 x 10^6 cfu/g, 30°C for 72h
Coli forms	Nil
Staphylococcus aureus	Nil
Bacillus cereus	Nil
Yeast and moulds	Nil
Escherichia coli	< 3/g
Salmonella	Nil
Clostridium	Nil

SNI 01-3551-2000 Instant Noodles
* INS = Indonesian National Standard

CHAPTER THREE

MATERIALS AND METHODS

3.1 Materials

Two types of indomie noodles (indomie chickens flavour and indomie vegetables flavour) samples were randomly produced from Sawabash factory(Soba industrial area).

The two types of indomie were analyzed before and after cooking. The cooking was at 100^{o}C for 20 minutes.

3.2 Chemical analysis

3. 2.1 Moisture content

The determination of moisture content was carried out on the samples according to AOAC. (2002) methods. Five grams of well-mixed samples were weighed accurately in clean preheated moisture dish of known weight by using sensitive balance. The uncovered dishes with the sample were kept in an air oven provided with a fan at 130°C for 8 hours. The dish was then covered and transferred to desiccators and weighed after cooled to room temperature. The loss of weight was calculated as percent of sample weight and expressed as moisture content:

$$\text{Moisture content \%} = \frac{W1 - W2}{\text{Sample weight.}} \times 100$$

Where:

W1 = Weight of sample + dish before oven dry.

W2 = Weight of sample + dish after oven dry.

3. 2.2 Ash content

The ash content of the samples was measured according to AOAC. (2002) methods. Three grams were weighed in empty crucible of known weight. The sample was heated in a Muffle-Furnace at 550°C until its weight is stable. The residue is cooled to room temperature after removed from a Muffle-furnace and placed in desiccators then weighed. The process was repeated until constant weight was obtained. Ash content was calculated using the following equation:

$$\text{Ash content \%} = \frac{W1 - W2}{\text{Weight of sample}} \times 100$$

Where:

W1 = Weight of crucible with ashed sample.

W2 = Weight of empty crucible.

3. 2.3 Crud Protein

The Crude protein of samples was determined by the micro Kjeldahl methods (AOAC, 2002). Amount of 0.2 gram of sample, plus 0.4 gram catalyst mixture (potassium sulfate + cupric sulfate 10:1 by wt) and 7.0 ml concentrated nitrogen free sulfuric acid, were mixed in a small Kjeldahl flask (100 ml). The mixture was digested for two hours, then cooled, diluted, and placed in the distillation apparatus. Fifteen milliliters of 40% NaOH solution were added and the mixture was heated and distilled until 50 ml were collected in a 100 ml conical flask. The ammonia evolved was received in 10 ml of 2% boric acid solution plus 3-4 drops of universal indicators (methyl red and bromo cresol green). The trapped ammonia was titrated against 0.02N HCL.

The percentage (g/100) of protein was calculated by using an empirical factor to convert nitrogen into protein as follows:

$$\text{Nitrogen \%} = \frac{TV \times N \times 14.00 \times 100}{\text{Weight of sample} \times 1000}$$

Protein % = (nitrogen %) X 6.25

Where:

AV = Actual volume of HCL used for titration (ml HCL – ml blank)

N = normality of HCL.

14.00 = each ml of HCL is equivalent to 14 mg nitrogen.

3. 2.4 Crude fibre

The crude fibre was determined according to the standard method of AOAC. (2002). Two grams of an air dried fat-free sample were transferred to a dry 600 ml beaker. The sample was digested with 200 ml of 1.25% (0.26N) H_2SO_4 for 30 minutes, and the beaker was periodically swirled. The contents were removed and filtered through Buchner funnel, and washed with boiling water. The digestion was repeated using 200 ml of 1.25% (0.23N) Na OH for 30 minutes, and treated similarly as above. After the last washing the residue was transferred to ashing dish, and dried in an oven at 105°C over night then cooled and weighed. The dried residue was ignited in a muffle furnace at 550°C to constant weight, and allowed to cool, then weighed. The fibre percentage was calculated as follows:

$$\text{Crude fibre \%} = \frac{(W1 - W2)}{\text{Dry sample weight}} \times 100$$

Where:

W1 = the weight of oven dry sample after treatment by H2SO4 and KOH

W2 = the weight of the treated sample after ashing.

3. 2.5 Fat content

Crude fat was determined according to the standard method (AOAC, 2002). Two g of sample were extracted with hexane for 8 hours using Soxhelt apparatus. The solvent was evaporated and later, the remaining crude fat was determined

$$\text{Fat content (\%)} = \frac{(W1 - W2)}{W3} \times 100$$

Where:

W1= weight of flask and ether extract

W2 = weight of empty flask

W3= initial weight of sample

3. 2.6Total carbohydrate content

The carbohydrates were calculated by difference. The sum of moisture, fat, protein and ash contents was subtracted from 100.

3. 2.7 Energy content (Kcal)

Gross energy content was calculated using the following formulae:

Gross energy (Kcal) = (9 x crude fat) + (4 x crude protein) + (4 x utilizable Carbohydrate).

3.3 Minerals determination

Minerals of raw and processed samples were extracted according to Pearson (1981). Each sample was burnt in a muffle furnace at 550°C for six hours and each crucible was cooled in the desiccators and weighed. Each sample was placed in a sand bath for 10 minutes after addition of 5 ml of 5N HCL. Then the solution was carefully filtered in a 100 ml volumetric flask and finally distilled water was added to make up to mark. The extracts were stored in bottles for further analysis. Minerals of Na, K, and P, were determined using atomic absorption spectrophotometer type AA-6800 Shimadzu, Japan.

3.3.1 Sodium and potassium

Sodium and potassium contents were evaluated by atomic absorption spectroscopy (Perkin Elmer Analyst 200, Perkin– Elmer, Norwalk, CT, USA), as described by AOAC Official Method 968.08. (AOAC, 2006)

3.3.2 Phosphorous content

Analysis of phosphorous was carried out according to the method of Chapman and Pratt (1961). Two milliliters of the extract were pippetted into a 50 ml volumetric flask. Ten milliliters of ammonium molybdate-ammonium vanadate reagent [22.5g of (NH_4) 6MO7O24-4H_2O in 400 ml distilled water +1.25 g ammonium vanadate in 300 ml boiling water + 250 ml conc. HNO_3, and then diluted to 1liter] were added. The contents of the flask were mixed and diluted to volume. The density of the color was read after 30 minutes at 470 nm using colorimeter (Lab System Analysis-9filters, J. Mitra and Bros Pvt. Ltd). A standard curve of different KH_2PO_4 concentration was plotted to calculate the ion phosphorous concentration.

Calculation:

$$P (\%) = \frac{R \times D \times 1000}{10^6 \times S}$$

Where:

R = Reading curve

D = Ash dilution

S = oven dry weight of sample

3.4 Determination of MSG content

This was done by titrimetry. Amount of 0.5g of each sample was dissolved in 20ml of distilled water and four drops of bromothymol blue indicator solution were added. This was titrated with 0.1M sodium hydroxide (NaOH) to a blue end point and the titer value, V was recorded. The percentage MSG was calculated thus:

$$\% \text{ MSG} = \% \text{ glutamic acid} \times 1.15$$

$$\% \text{ glutamic acid} = (V \times 14.71 \times 100) / (\text{weight of sample} \times 1000)$$

Where 1ml of 0.1M NaOH=14.71mg of glutamic acid and 1.15 is factor of MSG. V is titer value of sample in 1 ml.

3.5 Microbiological analysis

3.5.1 Sterilization of Glassware

Petri dishes, test tube, flask, pipettes…etc., were sterilized in hot air oven at 160 – 180 c° e put the oven they were for 2 to 3 hours before they were washed dried and packed in stainless steel cans or sometimes in aluminum foil.

3. 5.2 Sterilization of media

Culture media were prepared following manufacturing instructions then sterilized sterilization was achieved by autoclaving at 121 C° for minutes.

3.5.3 Preparation of serial dilutions

Ten gram of each sample were weighed aseptically and homogenized in 90 ml of sterile diluents (0.1%peptone water to give (10^{-1}) dilution. Aseptically 1ml from the dilution (10^{-1}) was transferred to a tube contains 9ml sterile diluent .This makes a dilution of (10^{-2})then the same way the preparation of serial dilutions was continued up to the(10^{-6}) (Harrigan,1998).

3.5.4 Total bacterial count

Total viable count of bacteria was carried out using the pour plate count method as described by (Harrigan, 1998). One ml of every dilution was transferred aseptically into sterile Petri dish and to each plate 15 ml of sterile melted plate count agar were added .The inoculums were mixed with medium and allowed to solidify. The plates were then incubated at 37°C for 48 hours .A colony counter machine was used to count the viable bacteria and the results were presented as cfu/g .

3.5.5 Presumptive test for coliforms

One ml of each of three first dilution (10^{-1}, 10^{-2}. and10^{-3}) was inoculated in triplicates of 9ml of MacConkey broth in test tubes with Duraham tubes. Then the tubes were incubated at 37°C for 48 hour .The production of acid together with sufficient gas to fill the concave of the Duraham tubes is recorded as positive presumptive test (Harrigan,1998).

3.5.6 Confirmed test for coliforms

A fermentation tube of brilliant green 2% lactose broth was inoculated by using sterile loop from every tube showing positive result in presumptive test. Then the tubes were incubated at 37°C for 48 hours. The most probable number of total coliform (MPN) was recorded by using the table of the most probable number from the combination of positive and negative tubes (Harrigan,1998).

3.5.7 Yeast and moulds

According to Harrigan.(1998), from suitable dilution of sample 0.1 ml was aseptically transferred onto solidified Potato-Dextrose Agar containing 0.1 gram chloramphenicol per one liter of medium to inhibit bacterial growth. The sample was spread all over the plates using sterile bent glass rod. Plates were incubated at 28C° for 72 hours. Colonies were counted using a colony counter and the result were presented as cuf/gram.

3.5.8 *Staphylococcus aureus*

Amount of 0.1 ml from every dilution was transferred on to surface of each sterile well solidified Baird parker agar medium in plates and spread all over plates using sterile bent glass rod .Then incubated for 24-36 hours at 37^0 C and the plates were examined for *Staphylococcus aureus* which appeared as black shine convex colonies surround by a clear zone of 2-5ml in width (Harrigan, 1998).

3.5.9 Detection of *Salmonella*

Twenty five grams of sample were weighed aseptically and mixed well with 250 ml sterile nutrient broth .This were incubated at 37°C for 24 hours. Then 10 ml were drawn aseptically and added to 100 ml of selenite cystine broth. The broth was incubated at 37°C for 24 hours. Then with a loop full streaking was done on solidified bismuth sulphite agar and plates were then incubated at 37°Cfor 72 hours. Black metallic sheen colonies indicated the presence of *Salmonella*. A confirmatory test was carried out by taking a discrete black sheen colony and sub culturing it in triple sugar iron agar tubes. Production of a black colour at bottom of the tube confirmed the presence of *salmonella* (Hrrigan, 1998).

3.6 Statistical analysis:

The results were subjected to statistical analysis system (SAS) by using two factors completely randomized design. The mean values were also tested and separated by using Duncan's Multiple Range Test (DMRT) as described by Montgonery (2001).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Chemical composition of indomie noodles

4.1.1 Moisture content

Table 4 shows the moisture content of uncooked chickens flavoured indomie and vegetables flavoured indomie samples which were 4.45% and 5.38% , respectively. This result is similar to the expected moisture levels according to Sanni *et al*. (2007) who reported the moisture content of indomie noodle samples which ranged from 4.95% to 5.87%. On the other hand the moisture content of the cooked indomie increased to 39.89% for the chicken flavoured indomie and to 40.84% for vegetable flavoured indomie, this increase may be due to efficiency of cooking or addition of water during the cooking process (Gurkin, 2002). The results of the moisture content for chicken flavoured indomie and vegetables flavoured indomie showed a significant difference ($P \leq 0.05$) even they were cooked or uncooked.

4.1.2 Ash content

As shown in table (4) The ash content of uncooked chicken flavoured indomie and vegetables flavoured indomie were 0.69% and 0.83% respectively. These results showed no significant difference between each other, and agreed with that reported by Eyidemir and Hayta (2009). The ash content of cooked chicken flavoured indomie and vegetable flavoured indomie, were 8.31% and 5.86 %, respectively. These results were significantly different among each other ($P \leq 0.05$).The increase in ash content in cooked indomie might be due to addition of salt, and spices to indomie noodles Ritthiruangdej *et al*. (2011) mentioned that the ash content of noodles depends on the quality of the flour which corresponds to the higher mineral content, the ash content of chicken flavoured indomie was slightly than that of vegetable flavoured ones .

4.1.3 Crude protein content

Table (4) shows the protein content of uncooked indomie noodles for both chicken flavoured and vegetable flavoured indomie, which were, 8.83 and 8.71%, respectively. Most of noodles are made from wheat flours containing 8–10% protein (Eyidemir and Hayta, 2009).

On the other hand, the protein content of cooked indomie noodles for both chicken flavoured and vegetable flavoured indomie, were, 2.55 and 2.59% respectively. These finding indicated that, there was no significant difference in compression between the two samples in their protein values even pre and after cooking processes. But it was noticed that, there was a remarkable reduction in protein content of the cooked indomie samples for both chicken flavoured and vegetable flavoured indomie, this variation might be due to; the water soluble protein which was diffused off the noodles.

4.1.4 Crude fibre content

Table (4) shows the crude fibre content of uncooked indomie noodles for both chicken flavoured and vegetable flavoured indomie, which were, 0.37 and 0.42%, respectively. These results agree with Oladunmoye *et al.* (2010) who reported between 0.40% and 2.60% crude fiber content.

The crude fibre content of cooked indomie noodles for both chicken flavoured and vegetable flavoured indomie, were, 0.18 and 0.23%, respectively. Ahmed and Campbell (2012) also reported value of crude fiber content of noodles made from 100% soft wheat flour ranged between 0.08% and 3.4%. These values indicated that, there was no significant difference between the two samples in their crude fiber values before and after cooking. Although a remarkable decrease was noticed in both samples after cooking, this reduction might be due to; the fiber content effect by cooking.

4.1.5 Fat content

Table (4) shows the fat contents of uncooked indomie noodles for both chicken flavoured and vegetable flavoured indomie, which were, 0.30 and

0.34%, respectively. This result is similar to finding of Suryaningrum *et al* .(2003) who reported the fat content of indomie noodle samples which ranged from 0.30% to 0.37%.

The fat content of cooked indomie noodles for both chicken flavoured and vegetable flavoured indomie, were, 0.53 and 0.43%, respectively. This result was comparable with the findings of Wirjatmadi *et al*. (2002) reported there was 0.49% of fat content on their noodles that made from wheat flour. These values indicated that, there was no significant difference between the two samples in their fat content before and after cooking. Although a remarkable increase was noticed in both samples after cooking, this increasing might be due to; the fat content is affected by added spices in indomie noodles after cooking process.

4.1.6 Carbohydrate content

Table (4) shows the carbohydrates of uncooked indomie noodles for both chicken flavoured and vegetables flavoured indomie, which were, 85.36 and 84.32%, respectively. Most of indomie noodles from wheat flour had the highest carbohydrate content (83.60%) as reported by Ahmed and Campbell (2012).

The carbohydrate of cooked indomie noodles for both chicken flavoured and vegetable flavoured indomie, were, 48.54 and 50.04%, respectively. These values indicated that, there was no significant difference between the two samples in their carbohydrate % before and after cooking, but it was noticed a remarkable decrease in carbohydrate% for both samples especially after cooking. This reduction might be due to; water soluble starch and gel formation by action of cooking.

4.1.7 Energy content (Kcal)

Table (4) shows the proposed energy (Kcal) of uncooked indomie noodles for both chicken flavoured and vegetable flavoured indomie, which were, 379.50 and 375.20 (Kcal), respectively. This result was comparable with the findings of Taneya *et al.* (2014) who reported the energy content of indomie noodle samples ranged between 370.85 and 390.93(Kcal).These values showed no significant difference between the two samples.

On the other hand, the proposed energy (Kcal) of cooked indomie noodles for both chicken flavoured and vegetable flavoured indomie, were, 209.10 and 214.40 (Kcal), respectively. These values indicated that, there was a significant difference between the two samples ($P \leq 0.05$) in their proposed energy (Kcal), especially after cooking, this reduction might be due to; water soluble protein and starch beside the gel formation by action of cooking.

4.1.8 Minerals content

Table (5) shows the proposed mineral elements which including (sodium, potassium and phosphorus) of uncooked indomie noodles for chicken flavoured and vegetables flavoured indomie, which were, (23.49, 215.20, 208.00) and (23.54, 220.90, 209.50 mg/100g), respectively. These values showed no significant difference in (sodium, potassium and phosphorus) elements between the two samples.

Table (4): Proximate composition of indomie noodles

Parameter	Chicken		Vegetable		$Lsd_{0.05}$	SE±
	Uncooked	Cooked	Uncooked	Cooked		
Moisture content (%)	4.45^{d} ±0.20	39.89^{b} ±0.09	5.38^{c} ±0.49	40.84^{a} ±0.49	0.6789^{*}	0.2082
Ash content (%)	0.69^{c} ±0.16	8.31^{a} ±0.06	0.83^{c} ±0.10	5.86^{b} ±0.53	0.5292^{*}	0.1623
Crude protein (%)	8.83^{a} ±0.13	2.55^{b} ±0.25	8.71^{a} ±0.28	2.59^{b} ±0.75	0.801^{*}	0.2456
Crude fiber (%)	0.37^{a} ±0.05	0.18^{b} ±0.04	0.42^{a} ±0.06	0.23^{b} ±0.03	0.0842^{*}	0.02582
Fat content (%)	0.30^{a} ±0.09	0.53^{a} ±0.10	0.34^{a} ±0.29	0.43^{a} ±0.03	0.3036^{NS}	0.09309
Carbohydrates (%)	85.36^{a} ±0.31	48.54^{b} ±0.21	84.32^{a} ±0.85	50.04^{b} ±1.75	1.863^{*}	0.5713
Energy (kcal)	379.50^{a} ±0.82	209.10^{c} ±0.85	375.20^{a} ±2.94	214.40^{b} ±3.78	4.641^{*}	1.423

Values are mean ±SD.
Mean(s) having different superscript(s)in rows are significantly different (P≤0.05).

On the other hand the proposed mineral elements of cooked indomie noodles for both chicken flavoured and vegetables flavoured indomie, were, (6.58, 86.90, 66.71) and (5.60, 76.03, 57.39 mg/100g) respectively. The results obtained in this study are in agreement with those reported by Xu *et al* .(2017). These values indicated that, there was a significant difference between the two samples (P≤0.05) in their content of potassium, especially after cooking. This variation might be due to; water soluble element and generally it was also observed that, the mineral elements decreased after cooking process, this might also be attributed to losses arising from the solubility of these elements in water.

4.2 Monosodium glutamate (MSG)

Table (6) shows the proposed monosodium glutamate which suggested to be in uncooked indomie noodles for chicken flavoured and vegetables flavoured indomie, which were0.00 and 0.00 mg/100g , respectively. These values showed no significant difference in the proposed monosodium glutamate between the two samples. On the other hand the proposed monosodium glutamate of cooked indomie noodles for both chicken flavoured and vegetable flavoured indomie, were3.57 and 0.00 mg/100g, respectively. These results agree with the accessible level determined by Loliger (2000). These values indicated that, there was a significant difference between the two samples (P≤0.05) in their proposed monosodium glutamate after cooking. This variation might be due to; the added substances during cooking process which may contains (MSG) and it differ from one company to another. According to the Indonesian National Standard(INS) the accessible level of(MSG) in indomie noodle was (10 –17 %), where the obtained level of (MSG) in chicken flavoured indomie sample (3.57 mg/100g), in comparison with that Indonesian National Standard(INS) , it was lower than the mention level.

Table (5): Minerals content (mg/100g) of indomie noodles

Flavour	Sodium-Na		Potassium-K		Phosphorus-P	
	Treatment*					
	Uncooked	Cooked	Uncooked	Cooked	Uncooked	Cooked
Chicken	23.49^{a} ±1.64	6.58^{b} ±2.56	215.20^{a} ±3.91	86.90^{b} ±5.52	208.00^{a} ±5.83	66.71^{b} ±2.64
Vegetables	23.54^{a} ±1.22	5.60^{b} ±0.12	220.90^{a} ±2.49	76.03^{c} ±0.64	209.50^{a} ±0.52	57.39^{b} ±5.62
$Lsd_{0.05}$	3.092^{*}		6.818^{*}		10.50^{*}	
SE±	0.8482		2.091		3.218	

Values are mean±SD.

Mean(s) having different superscript(s) are significantly different (P≤0.05).

Table (6): Sodium glutamate content (mg/100g) of indomie noodles

Flavour	Sodium glutamate	
	Uncooked	Cooked
Chicken	0.00^{b} ±0.00	3.57^{a} ±0.33
Vegetables	0.00^{b} ±0.00	0.00^{b} ±0.00
$Lsd_{0.05}$	0.0^{*}	
SE±		

Values are mean±SD.

Mean(s) having different superscript(s) are significantly different (P≤0.05).

4.3 Microbial properties of indomie noodles

Table (7) shows the microbiological investigations which were carried out for both samples to detect the total viable count, coliforms, yeast and moulds, *Staphylococcus aureus* and *Salmonella spp*. The results showed that, there was a significant difference between the two samples ($P \leq 0.05$) in their all microbial tests .On other hand total bacteria (6.5 $\log_{10}$ cfu/g) and *Staphylococcus aureus*(5.5 $\log_{10}$ cfu/g) were found only in chicken flavored indomie. These findings might be due to, direct contamination or might be due to the added appetizers. These results are in agreement with that of INS (2000).

Table (7): Microbiological features of endomie noodles

Parameter	Chicken		Vegetable	
	Uncooked	Cooked	Uncooked	Cooked
Total bacterial count ($\log_{10}$ cfu/g)	6.50 ±0.71	Nil	Nil	Nil
Total coliforms (MPN/g)	Nil	Nil	Nil	Nil
Yeasts and moulds ($\log_{10}$ cfu/g)	Nil	Nil	Nil	Nil
***Staphylococcus aureus* ($\log_{10}$ cfu/g)**	5.50 ±0.71	Nil	Nil	Nil
Salmonella	Nil	Nil	Nil	Nil

Values are mean ±SD.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

1. The un cooked indomie is of high energy and of high nutritive value.
2. Some processing companies of indomie allow using monosodium glutamate while others are not.
3. Cooking process of indomie noodle is completely inhibiting the growth of microorganisms.

5.2 Recommendations

1. Since uncooked indomie noodles exhibiting a high nutritive value, recommended to carry out a satisfactory pre cooking process to minimize or to avoid microbiological contamination.

2. It is recommended to avoid the excessive using of indomie noodles treated with monosodium glutamate, due to its harmful accumulative effect on human health**.**

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APPENDICES

Appendix: 1. Chicken flavored indomie

Appendix:2. Vegetables flavored indomie