PROJECT REPORT

ON

"Study of the development of Oats cereal based noodles and compared with mostly available commercial wheat supplemented noodles"

SUBMITTED TO

Prof. Dr. Md. Bellal Hossain
Head
Department of Nutrition and Food Engineering
Daffodil International University

SUBMITTED BY

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Date of Submission: 17-04-2019

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LETTER OF TRANSMITTAL

17 April 2019
To
Professor Dr. Md. Bellal Hossain
Head
Department of Nutrition & Food Engineering
Daffodil International University

Subject: Submission of Project Report**.**

Dear Sir,

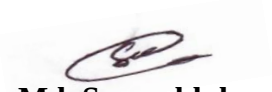
It is a great pleasure and honor for me to have the opportunity to submit me project work report on ***"Study of the development of Oats cereal based noodles and compared with mostly available commercial noodles in Bangladesh"*** as a part of the Nutrition and food engineering (NFE) program curriculum.

I have prepared this report based on the acquired knowledge during my project period.it is great achievement to work. Without your help, this report would have been impossible to complete. I have got the opportunity to work in **Bangladesh Council of Scientific and Industrial Research** for developed and analysis the product.

This is the first times this project gave me both academic & practical exposures. First of all I have gained knowledge about how oats noodles may prepared. Secondly, the project gave me the opportunity to analysis the chemical and nutritional components of it. Then I compared the oats noodles with local commercial noodles.

I therefore, would like to place this report to your judgment and your kind advice which will encourage me to perform better planning in future.

Sincerely Yours



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LATTER OF AUTHORIZATION

17 April 2019

To
Professor Dr. Md. Bellal Hossain
Head
Department of Nutrition and Food Engineering
Faculty of Allied Health Sciences
Daffodil International University

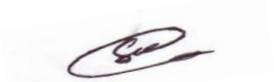
Subject: Declaration regarding the validity of the project report.

Dear Sir ,

This is my truthful declaration that the "project report". I have prepared is not completely copy of any thesis report previously made by any students.

I also express my honestly confirmation in support to the fact that the said thesis report has neither been used before to fulfill my other course related not it will be submitted to any person a authority in future.

Sincerely Yours



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CERTIFICATE OF APPROVEAL

We are pleased to certify that the project on **"Study of the development of Oats cereal based noodles and compared with mostly available commercial noodles in Bangladesh"** at Bangladesh Council of Scientific and Industrial Research (BCSIR) conducted by **Md. Suzauddula**, bearing ID No. **161-34-506** of the Department of Nutrition and Food Engineering, Faculty of Allied Health Sciences, DIU has been approved for presentation and defense. He have done this project under our supervision.

We are pleased to hereby certify that the data and findings presented in the report are the authentic work for Md. Suzauddula. We are strongly recommending for presenting the report by him for the partially fulfillment of his under-graduation. Furthermore he bears a strong moral character and a very pleasant personality. It has indeed a great pleasure worked with him.

We wish him all success in life.

……..	……
Dr. Tasnim Farzana,	**Professor Dr. Md. Bellal Hossain**
Principal Scientific Officer	**Head**
Institute of Food Science and Technology	Department of Nutrition and Food Engineering
Bangladesh Council of Scientific and	Faculty of Allied Health Sciences
Industrial Research (BCSIR)	Daffodil International University

ACKONWLEDGEMENT

I feel immense pleasure to express my greatest and deepest gratitude to the supreme of everything, the Almighty ALLAH to whom all praises go, who enable us to complete the project work successfully for the degree of Bachelor of Science in Nutrition and Food Engineering.

I am very much grateful and feeling proud to acknowledge **Professor Dr. Md. Ahmed Ismile Mustofa**, Dean, Faculty of Allied Health Sciences, Daffodil International University for providing me his valuable instruction and inspiration to build by based with such topic.

I wish to express my gratitude and appreciation to my project work supervisor **Professor. Dr. Md. Bella Hossain**, Head, Department of Nutrition & Food Engineering, Daffodil International University, Bangladesh under his guidance, perseverance throughout the progress of this project work and precious opinion.

I express greatest debt and sincere gratitude to my co-supervisor, **Dr. Tasnim Farzana,** Principal Scientific Officer, Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, for her scholastic guidance, valuable suggestions, sincere behavior, and all sorts of helps in completion of this thesis work.

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Last but not least, I would like to thank my parents for their moral encouragement.

The Author
April, 2019

THE RESEARCH WORK IS DEDICATED

TO

MY BELOVED PARENTS

LIST OF FIGURES

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LIST OF ABBREVIATIONS

BCSIR	- Bangladesh Council of Scientific and Industrial Research
IFST	- Institute of Food Science and Technology
et al.	-and other people
etc.	-etcetera = and the others
ml	-Milliliter
gm	-Gram
°C	-Degree Celsius
HCL	-Hydrochloric Acid
NaOH	-Sodium Hydroxide
H_2SO_4	-Sulfuric Acid
AOAC	-Association of Official Analytical Chemists
WF	-Wheat Flour
WFF	-Wheat Flour Fortified
WF	-Wheat Flour

Abstract

Now a days consumption of snacks is increasing with awearing their health benefits. Firstly the present study focused to introduce such a food which may not only catch attention of growing aged group but also support their health with trends food i.e. noodles. Secondly represent changes of several physical properties (cooking time, cooking loss, volume increase, water absorption) have occurred due to supplements of oats flour with wheat flour and identified the acceptable sample which may bring a product for commercialization. In this occasion this study subjected to supplements oats flour with wheat flour. Based on literature this study conducted and found that not only the raw oats flour is contain higher amount of nutrient and health benefits than wheat flour but also it is possible to transfer those nutrients among fortified noodles without significantly changing sensory properties compared with local noodles. Several number of sample were prepared for conducting the study which main different was only the percentage of oats flour replaced with wheat flour that is 20 %,25%, 30% and 35% accordingly and other ingredients such as CMC, corn starch, salt, were maintain at same percentage. Result of the study indicated that fiber, protein, ash content were increased with in the percentage of oats flour added but in case of minerals significant different did not observed. Where a liner increased of fiber content were found that the peak value was 0.87% where at local noodles (control) found 0.14%. This value may be highlighted to them who's have a risk CVD. The colours of oats flour fortified noodles were turning dark brown with increasing amount of oats flour. The orgaoleptic analysis revealed that supplementation of maximum 30% oats flour may be incorporated in noodles to gain considerably higher overall acceptability. Through this study both the essential information about proximate and quality characteristics of oats flour fortified nutrient enriched noodles for commercially production is tried to bring out.

Chapter One

Introduction

The Bangladesh population in mid-2016 was around 162.952 million and day by day it was increased but the country has a fixed land but the population would reach 218 million by 2050 and finally stabilize at around 260 million in mid-next century (Streatfield et al., 2008). Bangladesh's high poverty and undernutrition rates are exacerbated by frequent natural disasters and high population density. In 2010, the percentage of Bangladeshis living beneath the poverty line dropped to 31.5 percent. However, more than 17 percent of the population is still extremely poor and high levels of inequality have persisted over the same period[16]. For over population hear need to more food harvest but there have not enough space for it. So food fortification and food diversification may useful to face those problem l.e. improving nutritional status. In this case available and nutrient enriched resource should utilize such as rice, wheat, oats and other local cereals(IFPRI 2019).

In recent market, noodles prepared by wheat flour are tasty and convenient food products which are enrich in CHO but are not like that in essential nutrients (i.e. essential amino acid, minerals, dietary fibers, and vitamins)(Kudake et al. 2017). The nutritional status of noodles however can be improved by incorporating nutritional components that may oats flour. Oats flour products are prominently focused as the primary carriers of nutrition. Additionally, these are helps to minimize the quantity of wheat flour required. Hence this study was carried out with a perspective to improve the nutritional quality of wheat flour formulated noodles by supplementing maximum level of oat flour to wheat flour without significantly distressing its physical characteristics.

Noodle products are a staple food in many parts of Asia. Asian noodles made from wheat may be divided into two general classes based on the ingredients used: white salted noodles (WSN) made from flour, sodium chloride and water, and yellow alkaline noodles (YAN) made from flour, alkaline salts (such as sodium and potassium carbonate) and water (Asenstorfer et al., 2006). The type of salt, properties of the flour and the manufacturing process lead to a wide array of noodle types (Martin et al., 2008). Traditional noodles are claimed to lack other essential nutritional components such as dietary fiber, vitamins and minerals, which are lost during wheat flour refinement. Thus, noodle products which represent a major end-use of wheat, are suitable for enhancing health after incorporating sources of fiber and essential nutrients (Choo and Aziz, 2010). The development of new

products is a strategic area of the food industry. Consumers are demanding foods that show two main properties, with the first dealing with the traditional nutritional aspects of the food, whereas, as a second feature, additional health benefits are expected from its regular ingestion. These kinds of food products are often called nutraceutical foods. In a rapidly changing world, with altered food habits and stressful lifestyles, it is more and more recognized that a healthy digestive system is an essential factor in determining the overall quality of life (Brouns et al., 2002). Several studies have suggested that consumption of processed oats has several beneficial effects on human health.

The species of Oats is Avena sativa which is under the kingdom of Plantae and Genus of Avena. Generally Oats are familiar as edible starchy grain and easily cultivated in the temperate provinces of the globe such as Bangladesh, India, and Pakistan etc. Processed Oats has health benefits for human body, it may be used as well as breakfast and snacks (i.e. noodles) (Britannica 2017). Oat flours are the by-product ensuing from oat bran production has an ivory coloured appearance with consists of small particle-size endosperm and germ segments (Hahn et al. 1990).

Oats are identical source of fiber, mostly β-glucan, high in minerals, vitamins and antioxidants. Whole oats are the only source of a unique group of antioxidants called avenanthramides (Dimberg et al. 2001). Which have defensive role in contradiction of several complicated disease. More intake of whole-grain foodstuff such as oats is linked with a reduced risk of type-II diabetes (Salmero et al. 1997, Meyer et al. 2000), hypertension (Whelton et al. 2005) and cardio vascular disease (Jacobs et al. 1998, Liu et al. 1999). The Oats and derives foods also have beneficial health properties, such as reducing blood sugar and cholesterol stages. Foods processed with oats have expanded significant interest as a healthy food (Ahmad et al. 2010). Mainly raw oats have high level of nutrition fact such as CHO 66%, Fiber 11%, fat 7% , protein 17%, calories 117/serving [4] and also contain 7.7% moisture, 11% CP, 6% crude fat, 8.8% NDF, 1.56% ash (0.l0% Ca, 0.23% P), 4,265 kca/kg GE, 0.41% lysine, 0.36% threonine, 0.17% tryptophan, 0.21% methionine, 0.34% cysteine and β-D gluten. The β-D gluten is not only importance for its numerous industrial, nutritional and health aids but also for it's water binding capacity(between 3.14 and 4.52 g g−1) (Ahmad et al. 2010). In recent time both developed and developing region of world noodles became a popular snacks food for it's palatability and quick cooking time (Aydin et al. 2011).

Recorded that the last some decades, the consumption of noodles has greater than before significantly not only owing to the changes in customer mentality and perspective but also the nutritional consciousness among them (Mahmoud 2012). Being a popular food for all ages of people it can easily processed and fortified with both nutritious flour instead of wheat and several nutrients(i.e. Iron, Iodine, Vitamin A etc.). On the other hand price of noodles are reasonable for low income people corresponding with other instant foods. Therefore, the objective of this study was to use Oats flour as an ingredient to make noodles products of high nutritional quality with other health benefits. The effect of wheat flour substitution with oats flour was investigated in terms of the physicochemical, textural, cooking and sensory qualities of the dried noodles.

Chapter Two

MATERIALS AND METHODS

Location of Experiment

The study was carried out in the laboratory of Quality Control research section, Institute of Food Science & Technology, Bangladesh Council of Scientific & Industrial Research (BCSIR), Dr. Kudrat-E-Khuda Road, Dhanmondi, Dhaka -1205.

Materials

Locally available Wheat flour, Oats Flour, Salt Corn Starch, CMC, Water were used as ingredients for making the noodles.

Design of experiment

Experiment design was done to formulate maximum percentage of oats flour replacing wheat flour not only without affecting noodles texture significantly but also enriched other nutrients. Wheat flour is supplemented with oats flour as follows:

S_0 = 00 % OF + 100 % WF

S_1 = 20 % OF + 80 % WF

S_2 = 25 % OF + 75 % WF

S_3 = 30 % OF + 70 % WF

S_4 = 35 % OF + 65 % WF

Where,

WF= Oats Flour

WF= Wheat flour

Noodles formulation:

Noodles formulation is shown in the Table 1.

Noodles Samples					
Ingredients	**S0**	**S1**	**S2**	**S3**	**S4**
Wheat flour (%)	100.00	80.00	75.00	70.00	65.00
Oats Flour (%)	00.00	20.00	25.00	30.00	35.00
Corn Starch (%)	4.50	4.50	4.50	4.50	4.50
Salt (%)	1.65	1.65	1.65	1.65	1.65
CMC (%)	0.50	0.50	0.50	0.50	0.50
Water (ml) ±5	100	110	110	110	110

Noodles Making:

For preparation of plane noodles, high gluten containing 25gm wheat flour was selected where CMC 0.50 %, Salt 4.65%, Corn Starch 4% and Water 1.9% were taken for dough mixture. Dough mixture was prepared flowing 2 stage mixing process. It is a matter of regret that the smoothness of noodles depend upon how properly the mixing of dough was formed. After preparation of dough ball 15-30 minuet was kept the dough covering with wet towel for sulfide bond. Then the dough sheet was prepared and subjected it to noodles cutting tools. After cutting it was dried with air at room temperature for 3.30 hour (the time of drying depend upon environment)

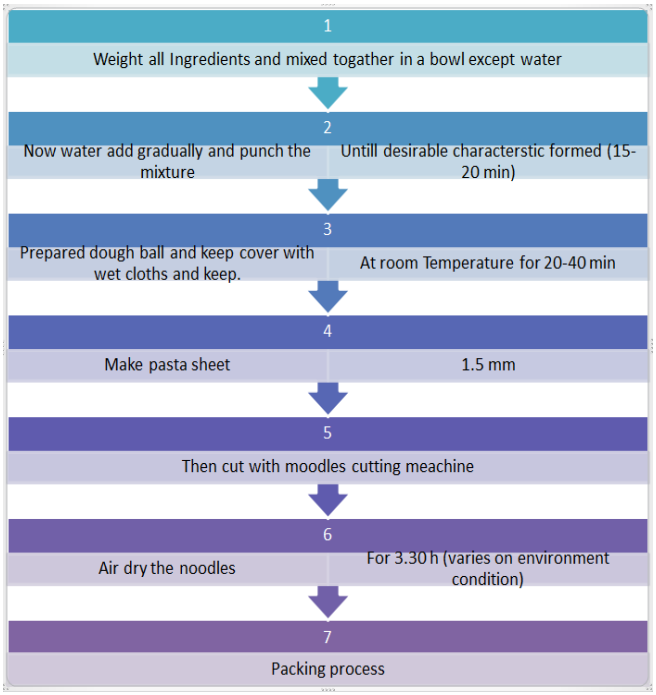

Figure 1 Steps of noodles preparation-1

During pretreating the trial sample the oats flour was replaced with wheat flour as 20 %, 25%, 30% and 35% but the added water as much needed to obtain a dough. Dough was

Figure 2 Dried sample noodles

covered with wet cloth & kept 30 min for uniform hydration & equilibrium. Noodles were prepared using noodle-making machine. Diameter of samples was approximately 1.5 × 1.5 mm (thickness × width). Air drying methods was used to dry the samples. After drying, dried noodles were collected & packaged in plastic bags.

Processing of noodles is described in the following flow chart:

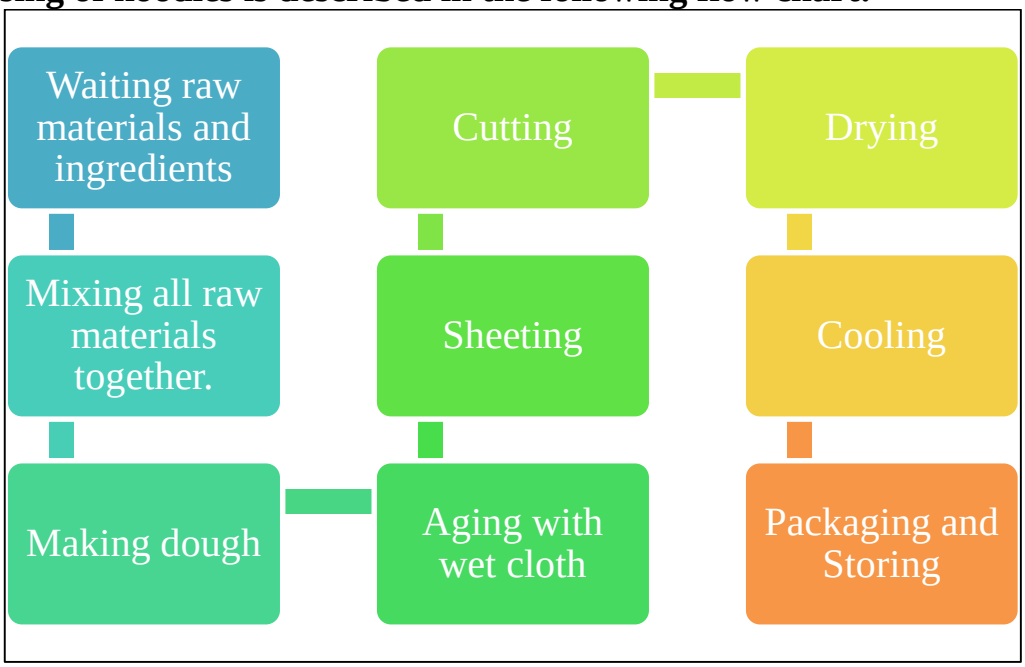

Figure 3: Flow chart for the processing of noodles-2

Methods

Determination of Moisture Content

Principle

The change of weight is estimated under certain temperature. Generally, the moisture content is determined by drying a sample at an elevated temperature and reporting the loss in weight as moisture (AOAC, 2005).

Apparatus

Analytical Balance, Crucibles, Laboratory Grinder, Drying Oven, Desiccators.

Procedure

Weight of crucible was measured and noted. Approximately 5.0 gm of sample was taken in the crucible. Again the weight of crucible and sample was taken and noted. Then the sample in the crucible was kept in oven at 105°C. Oven was started and continued for 5-6 hours. After heating, the dried sample was cooled to room temperature in desiccators. Then the weight of the dried sample was measured until the weight became stable.

Calculation

$$\%\ of\ Moisture = \frac{W_1 - W_2}{SW}(100)$$

W_1= Initial Weight

W_2= Final Weight

SW = Weight of sample taken

Determination of Protein content

Principle

Micro-Kjeldahl method is acceptable method for determining total nitrogen of crude protein in biological samples. This involves the oxidation of organic matter with Sulphuric acid in presence of catalyst and then formation of ammonium salts and amines from the nitrogen components of samples (AOAC, 2005).

Figure 4: Protein digestion and distillation

Reagents

Reagents used in Micro-Kjeldahl method were:

- N HCL: The concentration of the final solution was checked against pure sodium bi carbonate.
- N NaOH: The concentration of the final solution was checked against pure sodium bicarbonate.40% Sodium Hydroxide: 100 gm sodium hydroxide was dissolved to 250 ml of distilled water. Then the solution was stored in a bottle closed with a robber stopper. Catalyst for digestion: 2.5 gm powder selenium di oxide, 100.0 gm of K2SO4 and 20.0 gm of copper sulphate were mixed.

Procedure

0.2 - 0.5 gm sample was taken in a cleaned and dried digestion tube to which digestion mixture and 10.00 ml of concentrated sulphuric acid were added. The mixture was digested by continues heating till the mixture become clear (in “Kjeldahl nitrogen and distillation and distillation apparatus”). After digestion, solution was cooled and the volume was made to 100 ml with distilled water. Then10 ml of diluted sample and 40% NaOH were transferred in Kjeldahl distillation flask. Then the essence was collected through distillation in conical flask

where 10 ml 0.1 N HCl was taken and 1-2 drop of methyl red was added. Finally, the sample was titrated by 0.1 N NaOH.

Calculation

$$\%\ of\ Protein = \frac{(Bt - St) \times 1.4 \times 6.25 \times \text{strenght of NaOH}(.099) \times 10}{\text{SW}}$$

Bt = Titration Value of Blank

St = Titration Value of Sample

SW = Sample Weight.

Determination of Fat

Principle

Fat was estimated as crude ether extract of dry material (AOAC, 2003).

Apparatus

Analytical Balance, Soxhlet, Drying Oven, Conical Flask, Desiccators.

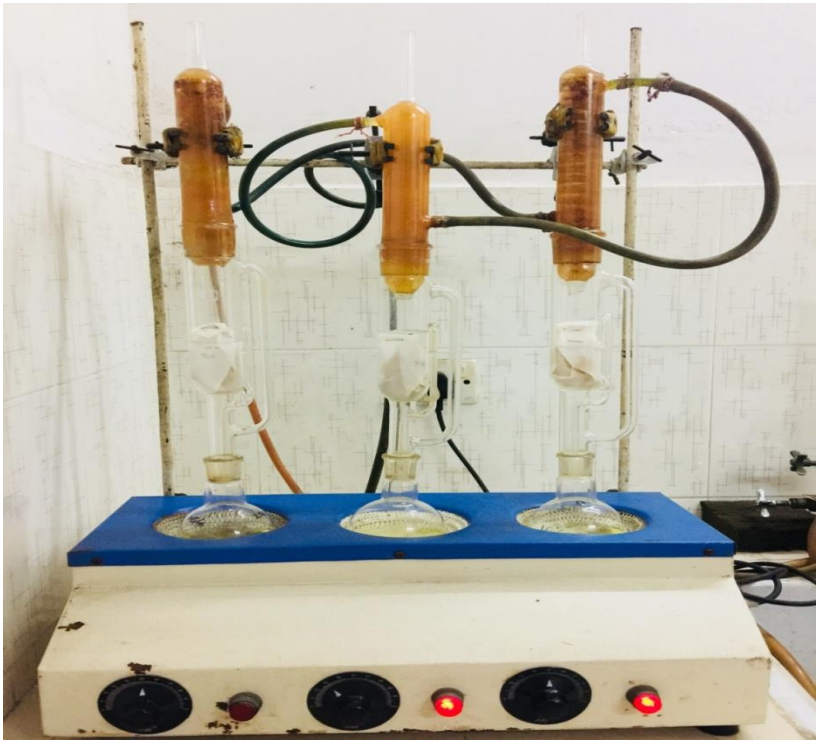

Figure 5: Reflux of fat

Reagents

Petroleum Ether.

Procedure

Around 15 gm sample was taken in thimble. The sample was refluxed in a Soxhlet with petroleum ether for 2 days. Then sample was distillated. Weight of a small conical flask was taken. The sample was poured into conical flask and petroleum ether was evaporated from sample with a hot plate. It was placed into an electric oven until the smell of petroleum ether was completely removed. Finally, the sample was cooled in desiccators and then weight of sample was taken.

Calculation

$$\%\ of\ Fat = \frac{W_2 - W_1}{SW}(100)$$

Where,

W_1= Weight of the empty conical

W_2= Weight of the conical with fat

SW= Original weight of sample

Determination of Crude Fiber

Principle

Crude Fiber was determined by using the official method of analysis (AOAC, 2005).

Reagents

Reagents used to determine crude fiber content were:

i. H_2SO_4 Solution: 13.2 ml of H_2SO_4 was taken in two liter volumetric flask containing about 1 liter distilled water and shake some time for well mixing. After mixing well the volumetric flask was made to two liters.

ii. NaOH Solution: 25 gm of NaOH was taken in a two liter volumetric flask containing about 1 liter distilled water and mixed well. After mixing well the volumetric flask was made to 2 liters.

Procedure

About 20 gm of crushed sample was taken and the sample was made free from fat by fat extraction method. The sample was dried and transferred to a 500 ml flask. 200 ml of H_2SO_4 was added and refluxed for 30 minutes with occasional rotation. The content of flask was filtered and after complete digestion washed with boiling water through a liner cloth. Wash residue was transferred back to flask by spatula.

200 ml of NaOH was added and refluxed for 30 minutes with occasional rotation. Then it was filtered through the same cloth and washed with boiling water. The residue was transferred to a crucible and dried at 110°C to a constant weight. The crucible containing dried residue was transferred to a muffle furnace and burnt at 600°C for 20 minutes. Weight of burnt sample was taken.

Calculation

$$\% \text{ of crude fiber} = \frac{\text{Weight after drying at } 110°C - \text{weight after drying at } 600°C}{\text{Weight of sample taken}}$$

Determination of Ash

Principle

The ash content was determined by ignition of a known weight of the food at 700°C at muffle furnace until all carbon has been burned and removed. The rest of the sample after this process is called ash and was taken to represent the inorganic constituents of food (AOAC, 2005).

Apparatus

Porcelain Crucible, Analytical Balance, Desiccators, Muffle Furnace.

Procedure

Weight of crucible was measured and noted. 1.5 to 2.0 gm of sample was taken in the crucible. Again the weight of crucible and sample was taken and noted. Then the crucible was placed on a gas burner and heated for primary combustion (heated order, low-medium-high). Then the crucible was put in a Muffle furnace for 6-7 hours at 700°C. After that period crucible was then cooled in desiccator and weighted. This procedure was repeated until two consecutive weights were same.

Calculation

$$\%\ of\ Ash = \frac{W_f - W_i}{SW}(100)$$

Where,

W*i*= Weight of the crucible + Sample before furnace

W*f*= Weight furnace

SW = Weight of sample taken

Preparation of mineral solution

For mineral solution 3.0 ml of HCl was added at sample in the ash at crucible. Then subjected to hot plate and wait until the color becomes yellowish then DI water was given until the solution became white. Then that was taken into a 100ml volumetric flask. De-ionized water was used to volume and prepared the mineral solution.

Determination of Sodium Potassium Iron Calcium content from ash content:

Standardization Na :

Concentration (PPM)	OD
0.5	0.50
1.0	0.60
2.0	1.0
4.0	1.9
6.0	2.6

Formula: $V_1S_1=V_2S_2$

One ml of mineral solution was taken and dilute 100 times with DI water. Later on the diluted sample was subjected to Flame Photometer to measure Na and K of sample.

Calculation:

$$\mathrm{X} = \frac{OD\ X \ldots\ldots\ldots}{2! \ldots\ldots..}$$

$$\text{Potassium/Sodium} = \frac{X\ x\ 1000}{SW}$$

Iron Calculation:

$$Y = \frac{RSPM\ X\ 100}{11.5}$$

$$Iron\ Value = \frac{Y\ x\ 100}{SW}$$

Calcium determination

- Mineral Solution (20 ml)
- Add Die {Methyle Red (2 drops)}
- Add Ammonium Solution
  - Until colour turn into Yellowish
- Subjected on hot plate
  - When start boiling add Ammonium oxalate(6%-10 ml)
- Boil Until colour turn pell yellow (then add Acetic Acid- 2-3 drops)
- Keep Worm at worm condition (1 h)
- Then wash with hot DI water in to conical (using Fannel, Filter paper)
  - Untill filtrate colour look clean
  - Then make a pour at bottom of filter paper and wash with 10 ml (.2N) Sulfuric acid and 50 ml hot DI water Accordingly

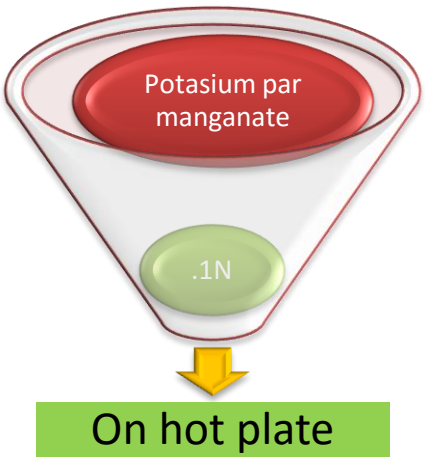

Figure 6 Calcium Determination

Determination of carbohydrate content

Carbohydrate content of sample was calculated by difference rather than direct analysis. Under this approach, the other constituents in the sample (Protein, fat, moisture, ash) were determined individually, summed and subtracted from the total weight of the sample (FAO, 1998; Pearson, 1976).

Calculation

% of carbohydrate= 100-(Moisture + Ash + Protein + Fat + Crude fiber)

Determination of Energy

Energy content of sample was calculated by Atwater's conversion factor rather than direct analysis. Under this approach, the other constituents in the sample (Protein, fat, carbohydrate) were determined individually, multiplied with conversion factors (AOAC, 2005).

Calculation

Energy content (Kcal) =(Carbohydrate×4+Fat×9+Protein×4)

Determination of Functional properties of noodles

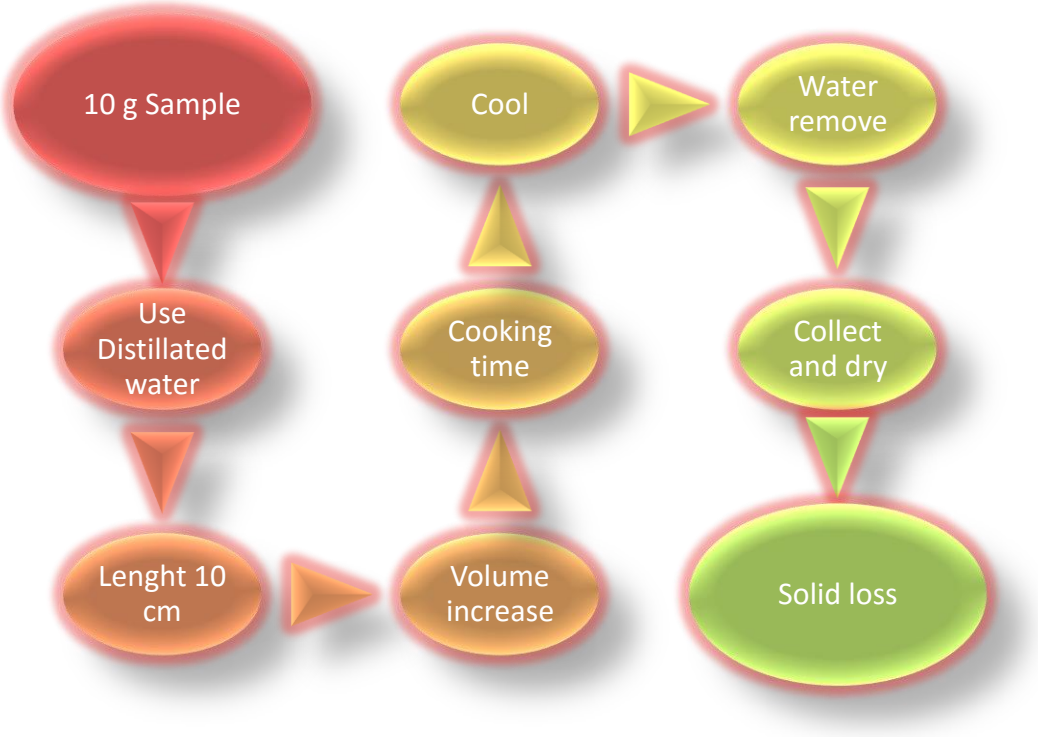

Figure 7: Sample preparation for Functional properties of noodles

Evaluation of cooking quality of noodles

Water absorption, cooking loss, and volume increase of noodles were measured according to the AACC methods 66-50 (20). The water absorption rate was measured by taking around 10 gm of fresh sample noodles then cooked in 150 mL H_2O for a suitable cooking time (Table: 4), cooling for around 5 min in cold water bath, and removing the water for 30 second. The cooking loss was measured after drying at 105^0 C for 24 h with the remaining water after measuring the water absorption rate. The volume increase rate was measured by filling 300 mL distilled water in a 500 mL mass cylinder and adding 10 g of fresh noodles and cooked noodles, respectively. All the analyses were conducted in triplicate. The respective formulae used in the calculations are as follow:

$$Water\ Absorption(\%) = \frac{Weight\ of\ Cooked\ Noodles(g) - Weight\ of\ fresh\ noodles(g)}{Weight\ of\ fresh\ noodles(g)} X\ 100$$

$$Cooking\ loss(\%) = \frac{Remaining\ solid\ content\ after\ drying(g)}{Weight\ of\ fresh\ noodles(g)} X\ 100$$

$$Volume\ increase\ (\%) = \frac{Volum\ of\ Cooked\ Noodles(ml) - Volume\ of\ fresh\ noodles(ml)}{Volume\ of\ fresh\ noodles(ml)} X\ 100$$

Sensory evaluation

Noodles in Bangladesh are prepared with chicken, beaf or vegetable gravy before consumption. However, 150 g of each sample noodles were cooked with half boiled carrot and borboti, (approximately 200 gm for each sample) (the mean cooking duration obtained for the noodles cooked in the soup). After then, 150 g of each sample was pleased in transparent glass plate, individually, marked with sample signed and presented to 07 in-house

Figure 8: Sample before sensory evaluation

semi and highly trained panelists. They assessed the samples in terms of color, texture, flavor, mouth feel, taste and overall acceptance using Hedonic 9 point scale and where scored them from 0 to 9 (1 for dislike extremely, dislike very much, 3 for dislike moderately, 4 for dislike slightly, 5 for neither like nor dislike, 6 for like slightly, 7 for like moderately, 8 for like very much and 9 for like extremely. The test was performed in isolated booths in a standard taste panel area under daylight illumination.

Chapter Three

Result and Discussion

Proximate composition of flours

Chemical properties of oats flour and wheat flour is given in Table 2. Where the results found that the oats flour is containing higher amount protein, crud fiber, fat ash and other minerals. It was observed that significant different between fiber content, where oats flour have 14.99% and wheat flour have 5.89%. In terms of protein contents of oats flour was 17.06% respectively more than wheat flour. Fat and ash content of oats flour were found 2.66% and 2.62% where wheats flour have lower level of those.

Table 2: Proximate analysis of raw materials

	Oats Flour (OF)	Wheat Flour (WF)
Moisture	7.39 %	9.74 %
Protein	17.06 %	10.84 %
Ash	2.44 %	0.26 %
C. Fiber	2.55 %	0.21%
Fat	2.62%	1.20 %
CHO	67.97 %	78.11 %
Energy	363.70 kcl	366.6 kcl
Calcium	8.94	7.58
Potassium	534.98 mg	132.70 mg
Sodium (ug)	403.13	100.15
Iron	6.01	5.10

Moisture Content

Moisture of sample was measured by drying oven where the range of moisture was between 9.5% to 9.11%. It was observed that with the increased of the present of oats flour the moisture content decreased (Table 3). From figure 9, moisture contents of these OF

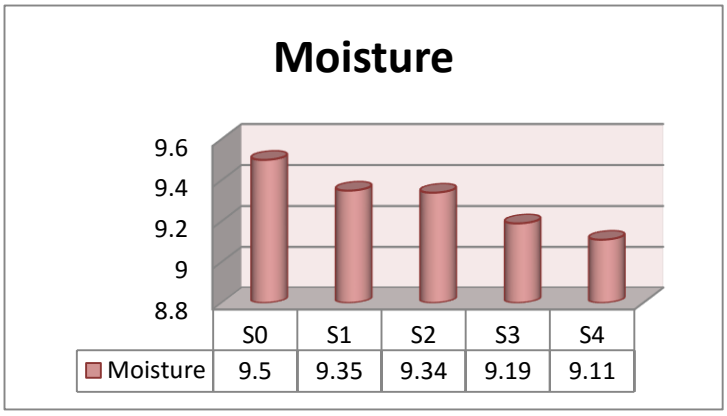

Figure 9: Moisture content of OF fortified noodles.

noodles which was measured through air at room temperature are ranked as follows:

$S_0>S_2>S_1>S_3>S_4$

The moisture content of OF noodles were increased than WF noodles cause water absorption rate of OF is higher than WF(Majzoobi et al. 2016). High moisture content leads to high microbial growth probability. Noodles containing 10 gm MP contains lowest amount of moisture as it contained highest amount of MP. During the study the moisture of raw matrials also measured where moisture content of wheat flour were found higher that oats flour that was 9.74 % and 7.39 %.

Ash content

Ash content of sample noodles were increased with the higher percentage of oats flour but the difference was not significant. The lowest percentage was found at S_0 and this sample was not contained any oats flour but in the term of high percentage was found at S_4 which was obtained 35% of oats flour.

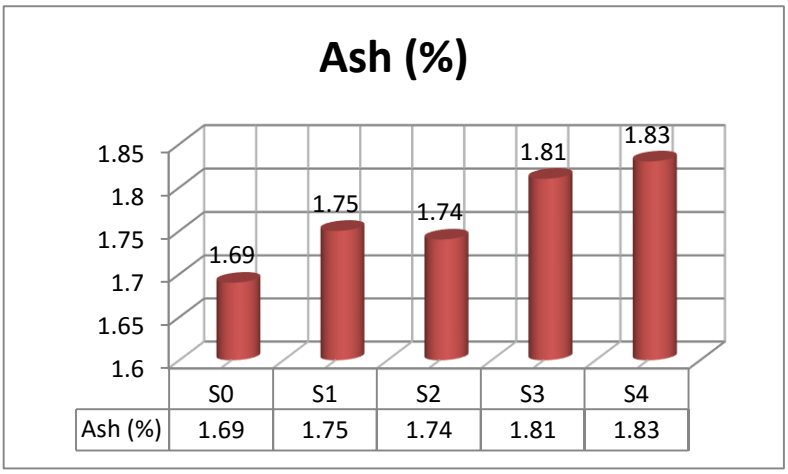

Figure 10: Ash content of sample noodles

Here except S_0 all sample were obtaining increased number of oats flour which frequency was 5%. Figure (10), shows ash content of sample noodles on dry basis are ranked as S0<S2<S1<S3<S4 Ash content of any food represents the total mineral contents of that food. The main mineral contents of ash are sodium, potassium, calcium, magnesium, sulfur, iron, zinc, copper, cobalt, manganese, and phosphorus. OF modified noodles analysis shows that there is a good amount of ash present. So, the mineral content will be good. Ash content increased because of OF contains a higher level of Ash (Table 3).

Proximate analysis of oats flour supplemented noodles:

Table 3 : Nutritive Values of oats flour supplemented Noodles

	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Fiber (%)	CHO ()	Energy (kcl)	Calcium (mg)	Iron (mg)	Potassium (mg)	Sodium (µg)
S_0	9.5	1.69	9.28	1.16	0.14	78.23	360.48	8.51	3.79	152.19	636.20
S_1	9.35	1.75	10.92	1.37	0.47	76.14	360.57	11.51	3.46	170.58	660.03
S_2	9.34	1.48	12.20	1.49	0.63	74.86	361.65	11.70	3.71	181.55	726.91
S_3	9.19	1.46	13.01	1.51	0.72	74.11	362.07	12.25	3.32	200.24	797.12
S_4	9.11	1.62	14.19	1.55	0.87	72.66	361.35	12.29	3.35	358.64	832.71

Where, S_0, S_1, S_2, S_3 and S_4 are 0, 20, 25, 30 and 35 percent OF noodles respectively.

Protein Content

The protein content of sample noodles were started form 9.28% and pic to 14.41 which was calculated with dry basis. The difference was noticeable form S0 and S4, which was found for adding oats flour (Table 2).

Here, S0, S1, S2, S3 and S4 are 0,20, 25, 30 and 35 percent OF noodles respectively.

Protein content of these MPF noodles on dry basis are ranked as S0<S1<S2<S3<S4

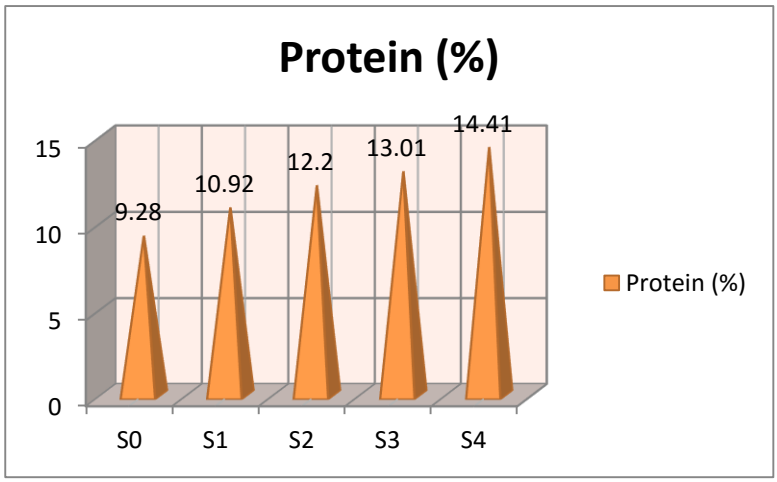

Figure 11 : Protein content of MP fortified noodles.

In this study protein content varied significantly. Protein percentage increased with the supplementation of oats flour. OF supplemented noodles contain more protein than WF noodles (Table: 2). that's why with the increased supplementation, protein content increased in the developed noodles (Table:3). Protein enrichment in pasta to non-instant noodles has been successfully done by other researchers (Bahnassey & Khan, 1986; Collins & Pangloli, 1997). This study also gave similar results. On the other hand our study on the proximate analysis on oats and wheat flour found that oats have significant different in terms of protein (Table 3). So the increasing amount of protein surely coming with increasing amount of oats flour.

Iron Content

Iron percentage of sample noodles were ranged from 3.79 mg to 3.32mg. In this analysis different types of pic found. The data did not linearly increased of decreased (Figure:12).

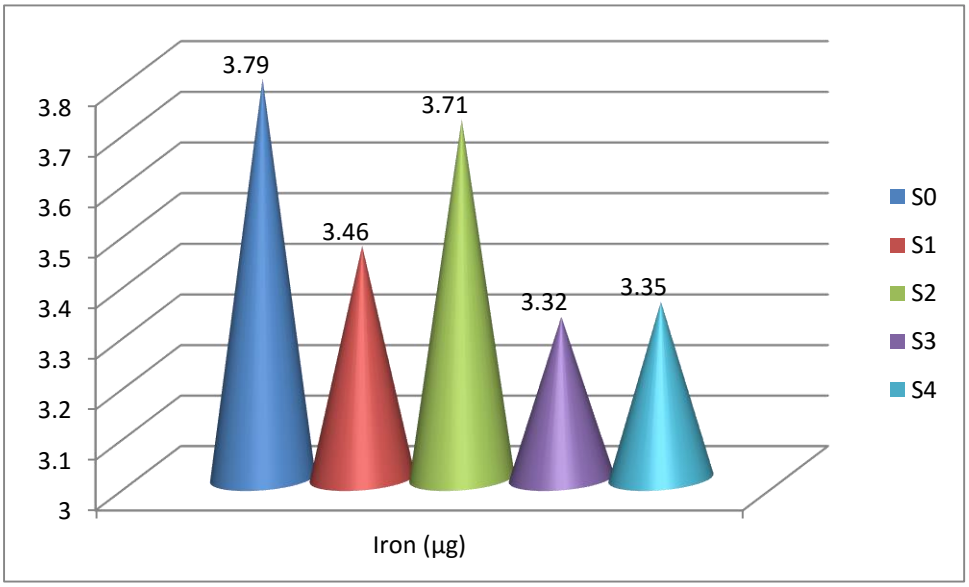

Figure 12: Iron content in different OF fortified noodles

No significantly difference has been shown in terms of iron among the sample noodles. Because there have a little different between raw materials i.e. oats and wheat flour was found 0.91 mg (Table: 2).

Potassium Content

Potassium percentage of sample noodles were ranged from 152.19 µg and reach height point at 358.64µg of sample S4. In terms of potassium the amount increased with higher portion of oats supplemented (Table 3).

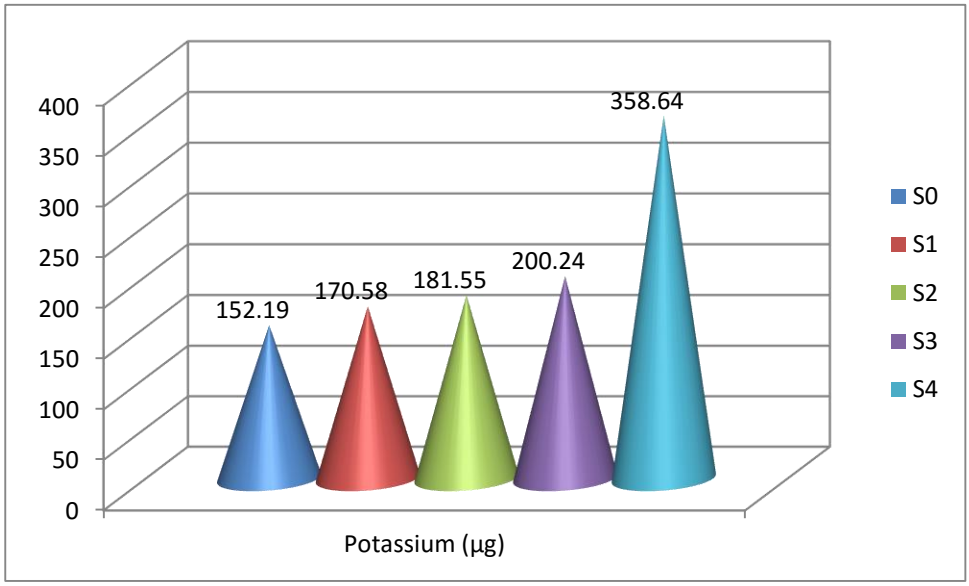

Figure 13 Potassium content in different MP fortified noodles

Supplementation with OF increased Potassium percentage in noodles. Potassium percentage is slightly higher in OF noodles than WF noodles cause K among raw OF have more than WF (Table 2).

Sodium Content

Sodium percentage of sample noodles were ranged from 636.20 µg and reach hight point at 832.71 µg of sample S4. In terms of Sodium the amount increased with higher portion of oats supplemented.

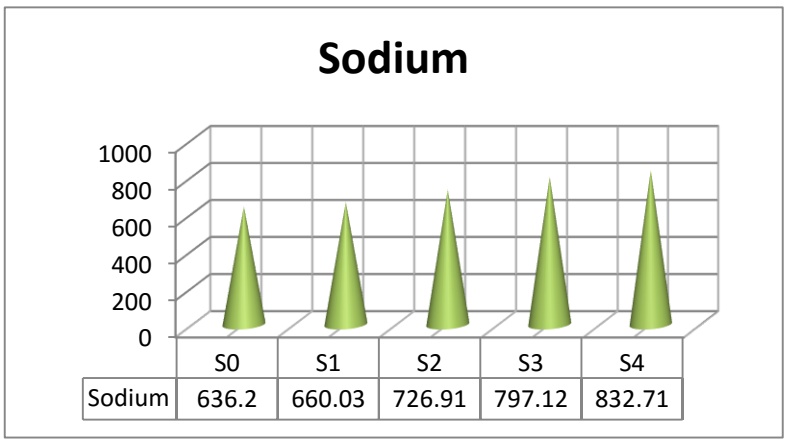

Figure 14 Sodium content in different OF fortified noodles.

Where, S0, S1, S2, S3 and S4 are 20%, 25%, 30% and 35% Oats flour supplemented noodles respectively.

Supplementation with oats flour increased sodium percentage in noodles. Sodium percentage is slightly higher in OF noodles than WF noodles (Table 3).

Fiber content

The main difference of proximate which mean's significant difference was observed in case of fiber content. The oats flour supplemented noodles are highly enriched of fiber. The local noodles that is S0 obtained 0.14% fiber where the 20% oats flour containing noodles have around 0.47% fiber and this range reach the peak at 0.87%.

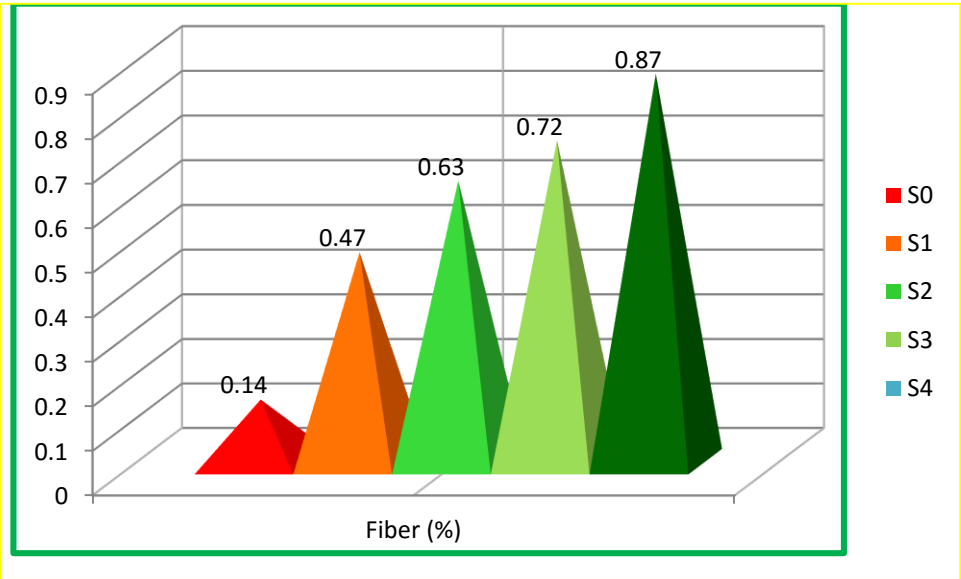

Figure 15: Fiber content in different OF fortified noodles.

Carbohydrate content

The percentages of Carbohydrate were observed decreasing with the increasing portion of oats flour. The study found that local noodles contained high amount of CHO where high oats flour containing noodles have low level of CHO. (Majzoobi et al,. 2016).

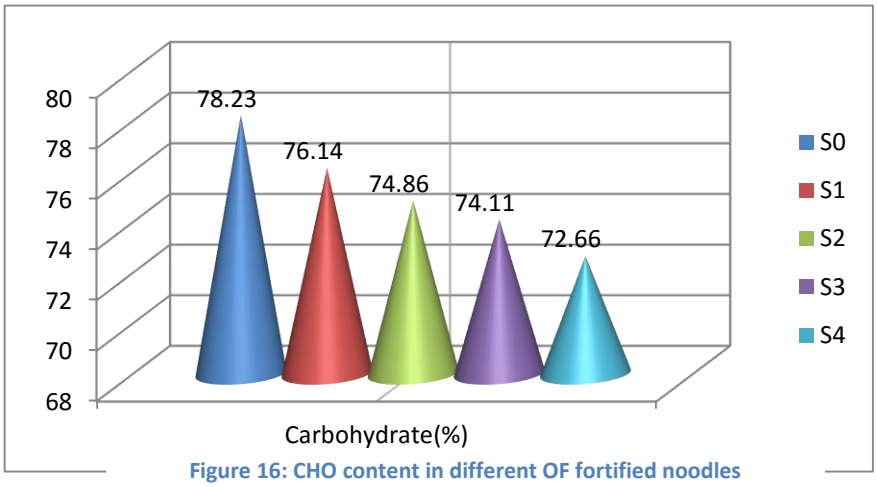

Figure 16: CHO content in different OF fortified noodles

Effect of oats flour fortification in noodles

Wheat flour have higher level of gluten than oats flour, (Kudake et al. 2017) so that higher percentage of oats flour containing dough were no suitable for noodles prepration.

On the other hand soft and viscous douth in not well for noodle prepration (Majzoobi et al., 2011). In this occasion for formulating well noodles, CMC (Carboxymethyl cellulose) was added with in a certain amount. The added CMC playes the role of thickener which prevent braking the cheaps of noodles without thickening agents and high percentage of oats flour containing dough doesn't support to get desirable structure noodles cause oats doesn't contain enough gluten for sulphur-sulphur bonding.(Hager. et al., 2012). A large number of hydrophilic groups in the molecular chain such as -OH groups and -COONa groups, so sodium carboxymethyl cellulose has better hydrophilicity and water-holding capacity than cellulose and it also can prevent water evaporation and aging. Since it has stronger high viscosity, in the frying process, it can reduce the oil content of instant noodles by 3% to 5%. The refined sodium carboxymethyl cellulose has early been recognized as a safe substance by the FAO and WHO (with an acceptable daily intake of 30mg /kg per person) (Sidley. 2019) . During this study only the percentage of oats and wheat flour were changed while other all condition and preparation methods were kept same for both fortified and control noodles.

Physical Properties of Sample noodles

Table: 4 presents that the **water absorption** of noodles was higher with the increasing amount of oats flour. The reason is oats flour have higher level of hydrocolloids and high number of hydroxyl groups. This hydroxyl property helps for water interactions by hydrogen bonding (Williams and Phillips 2005). So more oats flour more water absorbing characteristics were shown.

Table 4: Physical Properties of Sample noodles

	S0	S1	S2	S3	S4
Water Absorption (%)	142.48	147.62	146.35	152.32	156.15
Volume Increase (%)	189.62	179.48	139.14	131.21	120.70
Cooking Time (min)	3.51	2.53	2.25	2.20	1.56
Cooking Loss (%)	7.14	8.18	8.25	8.39	8.53

Our study found that increasing amounts of oats flour increased the water absorption into noodles while cooking and hydration. Noodles with high quality should remain a minimum loss of solids into the water during cooking (Wu and Corke 2005).

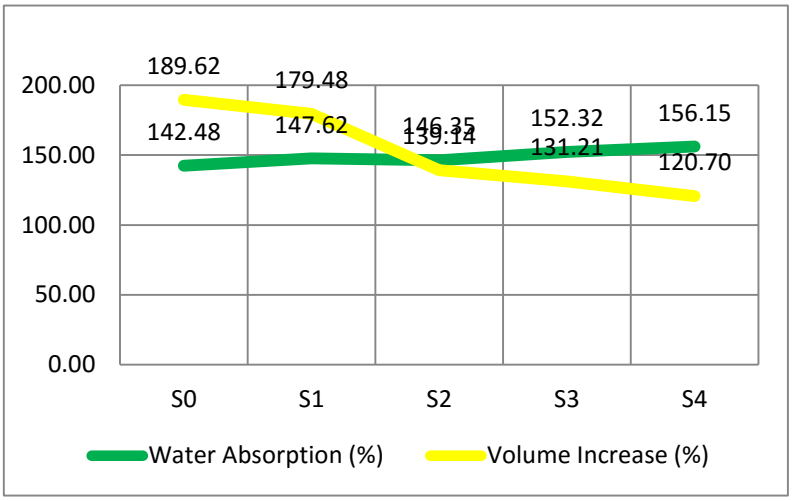

Figure 17: Water absorption and volume increase in different OF fortified noodles.

Figure 17 represents that the increasing amount of water absorption of the noodles while cooking is mainly due to the water absorbed by gluten and starch granules during gelatinization another study have done by Sozer and Kaya 2003. Higher amount of oat flour increased the water uptake of the samples. In terms of Volume Increase this study found that with the higher percentage of added oats flour the amount of Volume increasing decreased. It's means S0 (without oats flour) increased 189.62 % where oats flour containing noodles linearly decreased the parentages and last sample that is S4 shown the below percentage of Volume Increase that is 120.7% (figure: 17).

Again same types of flow were shown at figure 5, where S4 took very short time for cooked that is 1.56 minutes and compared with oats flour supplemented noodles wheat flour containing noodles take much time.

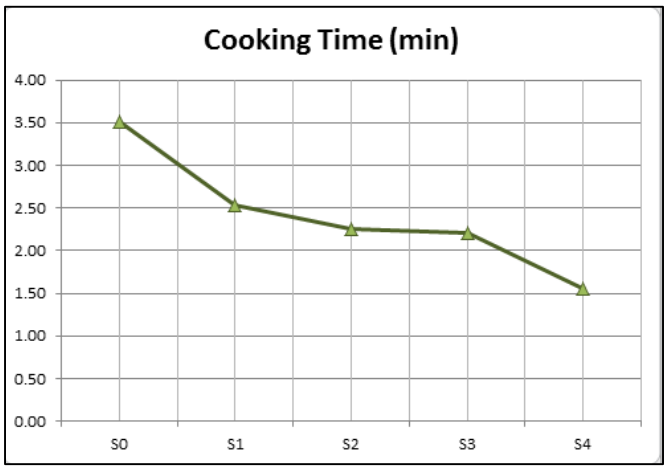

Figure 18: Optimum cooking time of different OF fortified noodles.

The cooking loss of oat noodles (**S1 to S4**) were increased with high percentage of oats flour (Table 4) which is also higher form those from local noodles which was the control of this study (**S0**) and without oat components. Noodles with good quality should maintain integrity without breaking during boiling. By increasing the oat flour percentage in the noodle recipe,the cooking loss of the samples also increases, significantly (Fig. 4A,B). The cooking loss varied

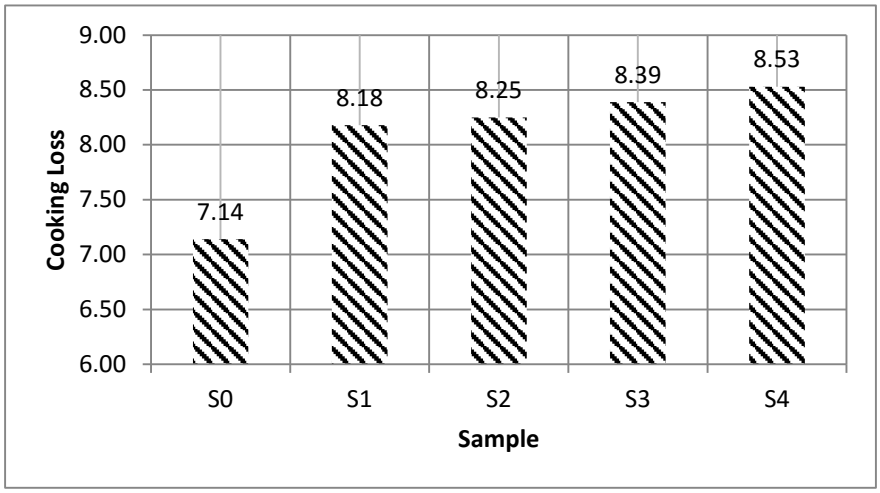

Figure 19: Volume increase after cooking of different OF fortified noodles.

from 1.1 to 3.5% for noodles cooked in distilled water and from 0.5 to 2.3% for those cooked in salted water. This can be related to high levels of water-soluble components in the oat flour, particularly *b*-glucan and proteins that enter the cooking water causing greater cooking loss. Negative correlation between the gluten content of the spaghetti and its cooking loss has been reported (Majzoobi et al. 2011b). Therefore, dilution of the gluten content of the noodles as a result of oat flour replacement can be another reason for high cooking loss of the noodles. The results also revealed that cooking of the samples in salted water reduced the cooking loss. Salt can support the gluten network, which can prevent soluble materials from readily exiting the noodles.

Table 5: Sensory Properties of Sample noodles

	Quality Factors					
Oats Noodles	**Color**	**Texture**	**Flavor**	**Mouth Feel**	**Taste**	**Overall Acceptance**
S0	8.8	7.4	7.0	7.3	7.3	7.2
S1	7.7	7.7	7.5	7.5	7.4	7.6
S2	7.6	7.6	7.3	7.9	7.6	7.0
S3	8.7	9.0	8.4	8.7	8.8	8.8
S4	6.8	7.3	6.7	6	7.0	7.0

Where, S0, S1, S2, S3 and S4 are 0, 20, 25, 30 and 35 percent oats flour supplemented noodles respectively.

Sensory analysis results (Table 5) showed that only the colour of S0 (control and locally available noodles) is higher than all other samples (S1 to S2). But there have not significantly difference between S0 and S3. In terms of the sensory evaluation of all samples were significantly lower in the sector of texture, flavor, mouthfeel test and overall acceptance. It was noticeable factor that lowest number of sensory evaluation were placed with sample S4, but height amount of oats flour (35%) was supplemented with wheat flour (Figure: 20). There have exact reason behind this reason, cause the study found that more oats flour containing noodles have shown a tendency to breakdown it's structure even during boiling or cooking. As panelist's mark, S3 was identified the best sample among rest of other.

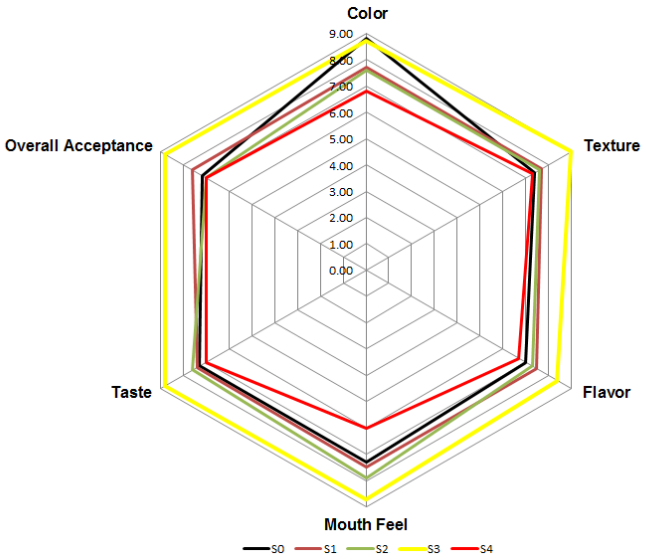

Figure 20: Sensory evaluation

Chapter Four

Conclusion

From last decay and recent aged demand of processed and formulated are increasing. Several food components can solve many difficult symptoms of human body. Recently the important of people are looking for healthy food which is use for them. Oats contain number and amount of nutrient compound as well as oats flour. Oats flour is more effective compared with wheat flour in séance of nutrition value. So that oats flour can be used for formulation of noodles as a percentage with wheat flour. Although some properties may change but not significantly, but the positive changes are many than negative. Such as higher amount of Fiber, protein, less cooking time and so many on the other hand cooking loss and change in colour are in negative side. However oats supplemented noodles up to 30% caused no significant problem which may be consider for commercialization. Hence the main inhabitation may be colour cause increasing the percentage of oats flour noodles became darker than local but the panelists comments that colour is not problem as tests were better even almost in all category 30% oats supplemented sample was best than other noodles.

Reference:

1) Britannica, T. E. (2017, April 24). Oats. Retrieved February 3, 2019, from https://www.britannica.com/topic/oats.
2) Dimberg, L. H., Sunnerheim, K., Sundberg, B., & Walsh, K. (2001). Stability of oat avenanthramides. Cereal chemistry, 78(3), 278-281. (https://doi.org/10.1094/CCHEM.2001.78.3.278)
3) Ahmad, A., Anjum, F. M., Zahoor, T., Nawaz, H., & Ahmed, Z. (2010). Extraction and characterization of β-d-glucan from oat for industrial utilization. International journal of biological macromolecules, 46(3), 304-309.(https://doi.org/10.1016/j.ijbiomac.2010.01.002)
4) Development, U. S., Of Agriculture. (2018, April). Oat bran, raw. Retrieved February 4, 2019, from https://ndb.nal.usda.gov/ndb/foods/show/20033?man=&lfacet=&count=&max=25&qlookup=raw oats&offset=&sort=default&format=Abridged&reportfmt=other&rptfrm=&ndbno=&nutrient1=&nutrient2=&nutrient3=&subset=&totCount=&measureby=&Qv=100&Q334028=1]+ / MS, A. B. (2015, March 25). Oats 101: Nutrition Facts and Health Benefits. Retrieved February 3, 2019, from https://www.healthline.com/nutrition/foods/oats#section1
5) Aydin, E. and Gocmen, D. 2011. Cooking quality and sensorial properties of noodle supplemented with oat flour. Journal of Food Science and Technology, 20 (2): 507-511. http://dx.doi.org/10.1007/s1006 8-011-0070-1
6) Mahmoud, E.A.M., Nassef, S.L. and Basuny, A.M.M. 2012. Production of high protein quality noodles using wheat flour fortified with different protein products from lupine. Annals of Agriculture Science, 57 (2): 105-112. http://doi.org/10.1016/j.aoas.2012.08.003
7) Jacobs DRJ, Meyer KA, Kushi LH, et al. (1998) Whole-grain intake may reduce the risk of ischemic heart disease death in postmenopausal women: the Iowa Women's Health Study. Am J Clin Nutr 68, 248–257. 2. (https://doi.org/10.1093/ajcn/68.2.248)
8) Liu S, Stampfer MJ, Hu FB, et al. (1999) Whole-grain consumption and risk of coronary heart disease: results from the Nurses' Health Study. Am J Clin Nutr 70, 412–419. (https://doi.org/10.1093/ajcn/70.3.412)

9) Whelton SP, Hyre AD, Pedersen B, et al. (2005) Effect of dietary fiber intake on blood pressure: a meta-analysis of randomized, controlled clinical trials. J Hypertens 23, 475–481. 4. (doi: 10.1097/01.hjh.0000160199.51158.cf)
10) Salmero ´n J, Manson JE, Stampfer MJ, et al. (1997) Dietary fiber, glycemic load, and risk of non-insulin-dependent diabetes mellitus in women. JAMA 277, 472–477. 5. (doi:10.1001/jama.1997.03540300040031)
11) Meyer KA, Kushi LH, Jacobs DRJ, et al. (2000) Carbohydrates, dietary fiber, and incident type 2 diabetes in older women. Am J Clin Nutr 71, 921–930. https://doi.org/10.1093/ajcn/71.4.921
12) Hahn, J. D., Chung, T. K., & Baker, D. H. (1990). Nutritive value of oat flour and oat bran. Journal of Animal Science, 68(12), 4253–4260. doi:10.2527/1990.68124253x
13) Kudake, D. C., Pawar, A. V., Muley, A. B., Parate, V. R., & Talib, M. I. (2017). Enrichment of Wheat Flour Noodles with Oat Flour: Effect on Physical, Nutritional, Antioxidant and Sensory Properties. International Journal of Current Microbiology and Applied Sciences, 6(12), 204-213. https://doi.org/10.20546/ijcmas.2017.612.026
14) Streatfield, P. K., & Karar, Z. A. (2008). Population challenges for Bangladesh in the coming decades. Journal of health, population, and nutrition, 26(3), 261.
15) IFPRI. (2019). Bangladesh. Food Security Portal. Retrieved from http://www.foodsecurityportal.org/bangladesh
16) Asenstorfer, R. E., Wang, Y., & Mares, D. J. (2006). Chemical structure of flavonoid compounds in wheat (Triticum aestivum L.) flour that contribute to the yellow colour of Asian alkaline noodles. Journal of Cereal Science, 43(1), 108-119.
17) Mares, D.J., Wang, Y. and Cassidy, C.A. (1997) Cereals 97. Proceedings of the 47th Cereal Chemistry Conference, RACI, Melbourne, Australia. 114-117.
18) Cosgrove, D.J., Daniels, D.G.H., Whitehead, J.K., Goulden, J.D.S. (1952) J. Chem. Soc. 4821.
19) Brouns, F., B. Kettlitz and E. Arrigoni. 2002. Resistant starch and the butyrate revolution. Trends Food Sci Tech. 13: 251–261.
20) WILLIAMS, P.A. and PHILLIPS, G.O. 2005. Introduction to food hydrocolloids. In Handbook of Hydrocolloids (G.O. PHILLIPS and P.A. WILLIAMS, eds.) pp. 1–20, Woodhead Publishing Limited, Cambridge, U.K.
21) Sidley Chem (2019) CMC Functional Properties in Food Applications. Retrieved March 26, 2019, from https://celluloseether.com/cmc-functional-properties-food-applications/

22) Hager, A. S., Wolter, A., Jacob, F., Zannini, E., & Arendt, E. K. (2012). Nutritional properties and ultra-structure of commercial gluten free flours from different botanical sources compared to wheat flours. Journal of Cereal Science, 56(2), 239-247.
23) MAJZOOBI, M., OSTOVAN, R. and FARAHNAKY, A. 2011a. Effect of hydroxypropyl cellulose on the quality of wheat flour spaghetti. J. Texture Studies 42, 20–30.
24) Kudake, D. C., Pawar, A. V., Muley, A. B., Parate, V. R., & Talib, M. I. (2017). Enrichment of wheat flour noodles with oat flour: Effect on physical, nutritional, antioxidant and sensory properties. International Journal of Current Microbiology and Applied Sciences, 6(12), 204-213.
25) Majzoobi, Mahsa, Aida Raiss Jalali, and Asgar Farahnaky. "Impact of Whole Oat Flour on Dough Properties and Quality of Fresh and Stored Part- Baked Bread." Journal of food quality 39.6 (2016): 620-626.