Characterization of Flour from Avocado Seed Kernel

Asia Pacific Journal of Multidisciplinary Research
Vol. 3 No. 4, 34-40
November 2015 Part V
P-ISSN 2350-7756
E-ISSN 2350-8442
www.apjmr.com

Macey A. Mahawan[1], Ma. Francia N. Tenorio[2], Jaycel A. Gomez and Rosenda A. Bronce
Chemical and Food Engineering Department, College of Engineering, Architecture and Fine Arts, Batangas State University, Alangilan, Batangas City, Philippines
macey.mahawan@gmail.com[1], ma.francia.tenorio@gmail.com[2]

Date Received: September 30, 2015; Date Revised: November 5, 2015

Abstract - *The study focused on the Characterization of Flour from Avocado Seed Kernel. Based on the findings of the study the percentages of crude protein, crude fiber, crude fat, total carbohydrates, ash and moisture were 7.75, 4.91, 0.71, 74.65, 2.83 and 14.05 respectively. On the other hand the falling number was 495 seconds while gluten was below the detection limit of the method used. Moreover, the sensory evaluation in terms of color, texture and aroma in 0% proportion of Avocado seed flour was moderate like and slight like for 25% and 50% proportions of Avocado seed flour. On the otherhand, the taste of the biscuits prepared with 0% Avocado seed flour was moderate like, in 25% proportion of Avocado seed flour were slight like and in 50% proportion was neither liked nor disliked. The overall acceptability results for 0% proportion of Avocado seed flour was moderate like and slight like for 25% and 50% proportions of Avocado seed flour. Furthermore, the computed p values for the comparison of the level of acceptability in terms of color, texture, aroma, taste and overall acceptability of biscuits using 0%, 25%, and 50% avocado seed flour were lower than 0.05. Thus the null hypothesis is rejected.*

Keywords - *Avocado, falling number, gluten, organoleptic, proximate analysis*

INTRODUCTION

Tropical trees play a very significant role in food security and poverty eradication in the Philippines. They provide readily available parts such as fruits, seeds, bark tannins and pulp which can be utilized for food, feeds and industrial uses. These include mango trees, banana and avocado trees.

Avocado is considered the world's healthiest fruit, because of its nutrient contents such as Vitamin K, dietary fiber, potassium, folic acid, Vitamin B6, Vitamin C, copper, and reasonable calories. It is one of the most recommended fruits as well as a food for body building and medicine for cholesterol-related diseases and it was found to have high cholesterol levels [1].

In the Philippines, two distinct types of avocado exist, namely the green-fruited and the purple-fruited types. Avocados are harvested with hand-held poles and baskets. Fruits are picked when mature but still hard. Avocado fruits on the same tree do not mature at the same time, so selective harvesting is usually practiced. Crop statistics, compiled by the Bureau of Agricultural Statistics of the National Statistics Office showed that the Philippines had a very large production of Avocado during 2000-2011 having an average production of 28973 MT annually. The highest production take placed in the year 2000 having a superior production of almost 38,086 metric ton [2].

Avocado seed, which is typically discarded as waste, is also a rich source of nutrients. The avocado seed, or pit, is the storage organ of the plant and contains a wealth of important nutrients. According to a study published by the California Avocado Society, avocado seeds possess a high concentration of potassium and phosphorus. Potassium maintains a steady heartbeat and fluid balance in the body. Phosphorus is needed for strong bones and synthesis of DNA and phospholipids, which carry fats through your bloodstream. Avocado seeds also contain a lower concentration of magnesium and calcium, required for blood clotting, muscle contraction and strong teeth and bones. In addition, avocado seeds contain 2.5% - 5% protein.[3].

There are several by-products from avocado seed which might be developed. Flour as an example could

be produced using seeds. Philippines do not commercially grow crops to be used as raw materials of flour production. Crops used in producing high quality flour are not adapted to tropical climate of the country such as wheat, barley, millet and rye. Philippines still import these raw materials from foreign based suppliers which mean lower cost of flour production and higher cost of consumer goods derived from it. Local based raw material source means lesser cost of production which means lower cost of flour and more affordable flour based products. Avocado tree has the capability of producing a continuous supply of fruits from which seeds can be obtained and even after harvest, the tree is not entirely damaged, unlike wheat and corn in which the plant harvested will only end up as a by-product and it is necessary to plant again to expect harvest in the next seasons. Since the demand for the fruit of avocado is high, there will also be a great volume of seeds.

Baked products are on top of the world demand for food and are mainly flour-based. Products such as bread, cookies, cakes and other baked products are a good source of energy giving nutrients. These products are obtained from a variety of cereals, which includes rye, wheat, barley and corn, processed to give high quality baking flour. The demand for these flour-based products is extensively high, which might lead to increase in raw material cost or worse, scarcity. Next to rice, flour based products are the most widely consumed food commodity in the Philippines. However, these products become costly and unaffordable to the least advantaged as materials used for flour based products are imported from other country. This interested the researchers to conduct a thorough study which would provide source of a raw material for flour and probably lessen the importation for flour, if not totally sustain the demand for flour in the country. The result of the study, therefore, will be of great help to industries and consumers.

The researchers conducted this study to produce seed flour from avocado. Hence, the researchers aimed to change the image of Avocado seeds from waste into a highly valued product in the industry. This research may contribute significantly to the attainment of national food security by providing new products such as Avocado seed flour.

OBJECTIVES OF THE STUDY

This study aimed to characterize flour from avocado seed kernel. Specifically, it aimed to determine the percent yield of flour from avocado seeds; to determine the properties of avocado seed kernel flour in terms of proximate analysis; gluten and falling number; to determine the organoleptic properties of biscuits from varied flour proportions namely; 0%, 25%, 50% and 75% avocado seed flour; to determine the levels of acceptability of biscuits from varied flour proportions namely; 0%, 25% and 50% avocado seed flour in terms of the following color; texture; aroma; taste; and overall acceptability; and to determine the levels of acceptability of biscuits from varied flour proportions namely; 0%, 25% and 50% avocado seed flour compare in terms of the above mentioned organoleptic properties.

MATERIALS AND METHODS

The study used an experimental method to determine the chemical properties of the prepared flour from the seed kernel of Avocado and its application in baking. The acceptability of biscuits produced was also determined.

Preparation of Sample

Avocado seeds served as a raw material for this study. The seeds were washed and the outer covering of the seeds were manually removed while washing. The washed seeds were chopped and air dried. For further drying, it was dried in an oven at 60° C for 5 hours.

Preparation of Flour

The mass of seed grains free of seed coatings prior to grinding was determined before drying. The seeds were then grounded in a pulverizer. Mesh no. 150 was used to separate the large lumps and finer particles of flour were obtained. The mass of produced flour were determined and the percent yield was calculated using the following formula:

$$\text{Percent yield} = \frac{\text{Actual mass of product}}{\text{Predicted mass of product}} \text{ x } 100$$

Determination of Ash Content

Three grams of sample was weighed into tared porcelain crucible. It was ignited in furnace at 550° C for two hours, cooled in desiccators and weighed. The percent ash was determined using the following formula [4].

$$\text{Percent ash} = \frac{\text{Initial weight} - \text{Final weight}}{\text{weight of sample}} \text{ x } 100$$

Determination of Moisture

Two grams of Avocado seed flour sample was placed on a pre-weighed covered dish and was dried to constant weight at 95˚C for five hours. [4].

The loss in weight was reported as follows:

$$\text{Percent moisture} = \frac{\text{Initial weight} - \text{Final weight}}{\text{weight of sample}} \text{ x } 100$$

Determination of Crude Protein

The crude protein of avocado flour sample was analyzed using Kjeldahl method.

Determination of Crude Fat

The crude fat of avocado flour sample was analyzed using Soxhlet method.

Determination of Crude Fiber

The crude fiber of avocado flour sample was analyzed using Weende method.

Determination of Total Carbohydrates

The total carbohydrate of the sample was determined by calculating the percent remaining after all the other components have been measured.

Determination of Gluten and Falling Number

The gluten content was determined using wet gluten test while falling number was determined using falling number method.

Preparation of Biscuit from Avocado Seed Flour in Different Ratio

Avocado seed flour was immersed in honey for 24 hours then it was dried in an oven for 100 ℃. After this, all raw materials needed like all purpose flour, buttermilk powder, butter, condensed milk, sugar, salt and baking powder were prepared. All dry ingredients were first mixed together followed by butter and condensed milk. After this, it was rolled out and was formed into desired shapes. It was then put inside an oven and baked at 250 ℃.

Table 1.Avocado Seed and Wheat Flour Ratio

Treatments	Ratio	Percentage Composition
Sample A	0:100	0% Avocado Seed Flour
Sample B	25:75	25% Avocado Seed Flour
Sample C	50:50	50% Avocado Seed Flour
Sample D	75:25	75% Avocado Seed Flour

Sensory Evaluation of Biscuits

The biscuits were evaluated for organoleptic properties such as color, texture, taste, aroma and overall acceptability by scoring method using nine-point hedonic scale. The evaluation was done by fifty panelists from Chemical and Food Engineering Department. The judges were given an evaluation sheet, instructed individually and requested to evaluate the biscuits.

The following continuum was used in the interpretation of results:

1.0-1.49 – Extreme dislike
1.5-2.49 – Slightly extreme dislike
2.5-3.49 – Moderate dislike
3.5-4.49 – Slight dislike
4.5-5.49 – Neutral
5.5-6.49 – Slight like
6.5-7.49 – Moderate like
7.5-8.49 – Slightly extreme like
8.5-9 – Extreme like

Statistical Treatment

The following statistical tools were used to analyze and interpret the collected data.

1. Mean. It was used to determine the chemical properties of avocado seed flour.
2. Weighted Mean. It was used to determine the levels of acceptability of biscuits produced using varied flour proportions.
3. One Way ANOVA. It was used to compare the levels of acceptability of the three biscuits produced in varied flour proportions.

RESULTS AND DISCUSSION

Percent Yield of Avocado Seed Flour

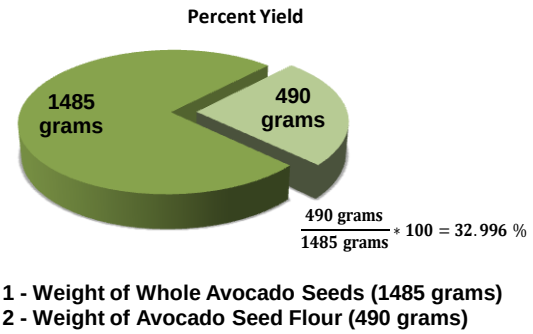

Figure 1. Percent Yield of Avocado Seed Flour

As shown in the figure, the percent yield of Avocado seed flour was 32.996%. The obtained percent yield in the study was higher compared to the result obtained by Olaeta et al (2007) from Hass Avocado which was 8.4%. This indicated that the flour content in Avocado seed could be affected by the variety of Avocado [5].

Table 2. Physical and Chemical Properties of Avocado Seed Flour

Parameters	Mean
% Crude Protein	7.75
% Crude Fiber	4.91
% Crude Fat	0.71
Total Carbohydrates	74.65
%Ash	2.83
%Moisture	14.05
Gluten	Below detection limit
Falling Number	495 seconds

As presented in the table, the percentages of crude protein, crude fiber, crude fat, total carbohydrates, ash and moisture were 7.75, 4.91, 0.71, 74.65, 2.83 and 14.05, respectively. On the other hand the falling number was 495 seconds while gluten was below the detection limit of the method used.

Protein content is a key specification for wheat and flour purchasers since it is related to many processing properties, such as water absorption and gluten strength. Protein content can also be related to finished product attributes, such as texture and appearance [6]. When proteins were combined with water, it forms gluten.

The result of the analysis indicated that there was a low amount of protein in avocado seed flour that would combine with water. Low protein content was desired for crisp or tender products, such as snacks or cakes while high protein content was desired for products with chewy texture, such as pan bread and hearth bread[6]. In addition, flours containing higher protein contents were more expensive than flours of lower protein content. Likewise, flours with very low proteins for cakes were also more expensive. There was usually, but not always, a good correlation between protein content and bakery performance of flour[7].

Furthermore, the obtained value was lower than the protein content of wheat which was 12.4 percent.

Crude fiber was a measure of the quantity of indigestible cellulose, pentosans, lignin, and other components of this type in present foods[8]. The result of the analysis showed that avocado seed flour could be a good source of fiber. Fiber is essential for the normal excretion of wastes materials in human and animal systems.

Crude fat determines the free fatty lipids of flour. This property can be used as the basis in determining processing temperatures as well as auto-oxidation which can lead to rancidity and can also affect flavor of food. The obtained fat content from avocado seed flour is lower than the average fat content of wheat. This may mean that it will not easily rancid when stored compared to the wheat flour.

Avocado seed flour has high total carbohydrate content. It is an indication that its starch content is also high. Starch is the principal carbohydrate which provides the supporting structure of bread. The starch will help in the dough formation in making bread. High carbohydrate content of the avocado seed flour also shows that this flour can be a best energy-giving food.

Ash content refers to the mineral content of flour. The percent ash of avocado seed flour is higher as compared to the ash content of average wheat which is 1.8%. This may also indicate that it has more minerals than that of wheat. Bakers needs to know the quantity of ash as it will have an impact on water absorption, nutrition (mineral content), fermentation activity, breakdown of gluten during mixing, color of the dough, etc. Yeast feeds on the minerals, so the greater the ash content, the more fermentation activity. Ash in flour can also affect color, imparting a darker color to finished products. Some specialty products requiring particularly white flour call for low ash content while other products, have high ash content [9].

The moisture provides the measure of water content and total solid content of flour. It also determines the storage ability and quality of flour. The higher moisture content of above 14.5% attracts mold, bacteria, and insects all of which cause deterioration during storage. The result of the moisture content of the avocado seed flour shows that it has high moisture content. However, this moisture content still falls within the standard range for flour specification which is 13%-15%. High moisture may lead to spoilage and lump formation during storage. Flour with high moisture cannot store well for more than a week or two. It could get musty which means that it is not stable at room temperature. Organisms naturally present in the flour will start to grow at high moistures, producing off odors and flavors. On the

other hand lower moisture content can cause loss to the baker in terms of low dry matter. Based on the results, the determined level of moisture in avocado seed flour has great potential to hold longer shelf life compared to other flours.

Gluten is a form of gluten in the flour. It is responsible for the elasticity and extensibility of the flour dough. Result of wet gluten test indicated that the gluten content was below the detection limit of the methods. This further indicated that avocado seed flour could not develop dough thus it could not be used in bread making.

Falling Number measures the level of amylase activity in the flour. High falling number indicated low amylase activity. Result indicated that the avocado seed flour falling number of 495 seconds was very high. This further indicated that the avocado seed flour had very low enzyme activity which also meant that Avocado seed was not germinated. Furthermore, the result suggested that when avocado seed flour was used in baking, the bread would not be developed, with low volume and would be too dry. Thus, it was not applicable for baking breads. The falling number result also indicated that the flour could be used in biscuits and blending with wheat flour could be a good strategy.

Organoleptic Properties of Avocado Seed Flour

Organoleptic properties were determined in terms of color, texture, aroma, taste and overall acceptability based on flour proportions namely: 0%, 25%, 50% and 75% Avocado seed flour.

Table 3.Organoleptic Properties of Avocado Seed Flour

Proportions	0%	25%	50%	75%
Color	Light brown	brown	Dark brown	Dark brown
Texture	Crunchy	Slightly crunchy	chewy	Not Acceptable
Aroma	Sweet	Sweet	Sweet	Sweet
Taste	Milky	Slightly bitter	Bitter	Not Acceptable
Overall Acceptance	Moderate like	Slight like	Slight like	Not Acceptable

In table 3, it was clearly depicted that there was a general decrease in the weighted mean of the organoleptic properties as the proportion of the avocado seed flour increased. In terms of color, the 0% proportion of avocado seed flour had a lighter color than the 2 proportions. 25% had a brown color and the 50% had dark brown color. As the percent of Avocado seed flour increased, the color became darker due to anthocyanin content of the seed. The sweet aroma of the three avocado seed flour proportion was contributed by honey. The proportions of 25% and 50% avocado seed flour had a bitter after taste due to the tannin content and the 0% proportion taste like that of normal biscuit. The 0% and 25% had a crunchy texture and the 50% was chewy. This was due to the difference in quality of flour used. And in the overall acceptability, the 0% proportion was moderate like and the 25% and 50% was slight like.

The biscuit having 75% Avocado seed flour was also prepared by the researchers, but it was not formed. Based on table 6, as avocado seed flour increased, crunchiness of flour decreased. The reason for this was that the gluten that held the structure of biscuits tends to lessen as avocado seed flour was added. This gluten was found mainly in commercially available flour that was being used as a standard.

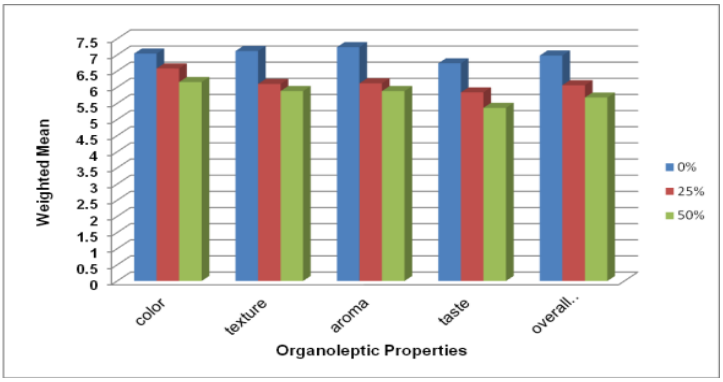

Figure 2. Levels of Acceptability of Biscuit

For the sensory evaluation, Figure 2 showed the levels of acceptability of the biscuits produced using varied proportions of avocado seed flour. In 0% proportion of Avocado seed flour in terms of color, the weighted mean was 7.04 with verbal interpretation of moderate like. For 25% and 50% proportions the weighted mean were 6.58 and 6.16 respectively with verbal interpretation of slight like. This showed that as the percentage of the avocado seed flour increased the color of the biscuits also got darker. This was due to the anthocyanin pigments found in the seeds of avocado which was responsible for the change of color upon contact with oxygen.

The weight mean in terms of texture in 0% proportion of avocado seed flour was 7.12 with verbal interpretation of moderate like. Also, the weighted mean for 25% avocado seed flour proportion was 6.10 with the verbal interpretation of slight like and for 50% flour proportion, the weighted mean was 5.88 with verbal interpretation of slight like. This implied that the biscuits derived from 0% flour proportion were perceived as being crunchy while the 25% proportion was perceived to have a slightly crunchy texture. Moreover, 50% flour proportion were seemed to have a different sensation on the mouth and perceived to be somewhat chewy. The different sensation on the mouth which appeared to be more visible as the enrichment of avocado seed flour increased contributed to this variation of texture. This was due to the differences of the quality of flour used. The commercially available flour was apparently finer as compared with the flour derived from avocado seeds so when the combination of the two flours was made, this difference became more apparent since they did not blend evenly and some avocado fiber was still noticeable.

The weighted mean in aroma decreased with increase in the ration of avocado seed flour. Weighted mean resulted to 7.24 for 0% proportion with a verbal interpretation of moderate like. For 25% and 50% proportions, the weighted mean were 6.12 and 5.88 respectively with verbal interpretation of slight like. Based on the sensory evaluation conducted, the aroma of biscuits made in three proportions was sweet. This was due to different ingredients added such as butter, buttermilk and condensed milk.

As the percentage of avocado seed flour increased, the weighted mean in terms of taste decreased. The 5.36 weighted mean value of 50% avocado seed flour resulted as being neither liked nor disliked. For the 25% proportion of avocado seed, its weighted mean was 5.84 and interpreted as slight like and for the 0% proportion, the weighted mean was 6.74 with verbal interpretation of moderate like. Avocado seed flour was first immersed in honey so as to lessen its bitterness. Honey was added on the proportion of 1:1. After 24 hours of immersion, honey was absorbed entirely by the flour. Although it was added to enhance taste, panelists still detected the bitter taste which could not be covered at all.

Avocado pits contained a milky and bitter liquid which turned red upon contact with oxygen in the air and this was due to high concentration of tannin in avocados. This compound contributed significantly to the taste as well as mouth feel of the biscuits which was more visible with those samples having a 50% proportions.

The level of acceptability of biscuit in terms of overall acceptability was evaluated. As shown in Figure 2, there was a general decrease in the scores of overall acceptability with increase in the percentage of avocado seed flour. The 0% flour proportion had a calculated mean of 6.98 with verbal interpretation of moderate like. For 25% proportion, it had a weighted mean of 6.06, and interpreted as slight like. And for 50% proportion, its calculated weighted mean was 5.68 with verbal interpretation of slight like.

It was evident from the figure that biscuits with avocado seed flour did not gain enough acceptability compared to the control. This might be attributed to the distinctive taste which left different sensation on the mouth which contributes mainly on its aftertaste.

Comparison of the levels of acceptability of biscuits from varying flour proportions in terms of organoleptic properties

Table 4.Difference on the Levels of Acceptability from Varying Avocado Seed Flour Proportions

Organoleptic Properties	p-values	Computed F-values	Decision on Ho	VI
Color	.003	6.17	Reject	HS
Texture	.000	22.56	Reject	HS
Aroma	.000	11.57	Reject	HS
Taste	.000	16.67	Reject	HS
Overall acceptability	.000	14.24	Reject	HS

**VI-Verbal Interpretation; HS-Highly Significant; p< 0.05*

The computed p values for the comparison of the level acceptability in terms color, texture, aroma, taste and overall acceptability of biscuits using 0%, 25%, and 50% avocado seed flour were lower than 0.05. Thus the null hypothesis was rejected. Therefore, there was highly significant difference among the three biscuits in terms of color, texture, aroma, taste and overall acceptability.

As presented in the table, 0% and 50% and 0% and 25% differed significantly in terms of color, aroma, taste and texture. This indicated that none of the two biscuits produced using avocado seed flour was comparable to the biscuit produced using 100 grams of commercial flour. However, based on the verbal interpretation using acceptability test, the

biscuit produced using 25% and 50% were slight like with respect to color, aroma, texture and taste.

Table 5.Summary of Significant Pair-wise Difference on the Level of Acceptability from Varying Avocado Seed Flour Proportions

Organoleptic Properties	Pair	Mean difference	p-values	VI
Color	0% vs 50%	0.88	0.003	HS
Aroma	0% vs 25%	1.12	0	HS
	0% vs 50%	1.36	0	HS
Taste	0% vs 25%	0.9	0.01	HS
	0% vs 50%	1.38	0	HS
Texture	0% vs 25%	1.02	0	HS
	0% vs 50%	1.24	0	HS
Overall acceptability	0% vs 25%	0.92	0	HS
	0% vs 50%	1.3	0	HS

**VI-Verbal Interpretation; HS-Highly Significant*

CONCLUSION AND RECOMMENDATION

Based on the findings presented, the researchers came up that the Avocado seeds were good source of flour and that itcontained high levels of minerals, carbohydrates and fibers. However, it was not applicable for bread making due to its very high result of the falling number and the undetected amount of gluten.

The biscuits produced using 0%, 25%, and 50% avocado seed flour have acceptable organoleptic properties.In terms of its color, the biscuits using 0%, 25%, and 50% avocado seed flour was moderate like, while the texture, aroma, taste and overall acceptability of biscuits from 25% and 50% avocado seed flour are slightly like. Likewise, there has been a highly significant difference among the biscuits using 0%, 25%, and 50% of avocado seed flour in terms of color, taste, texture, aroma and overall acceptability.

For further study, the researchers strongly recommend to conduct a study focusing on the removal of tannins in Avocado seed flour to improve the quality of flour that will be produced.

A parallel study using a specific variety of Avocado in the Philippines should also be conducted. Application of Avocado seed flour in preparing other baked products should be studied.

Furthermore, a test for microbial analysis, packaging and shelf life of the flour produced should also be conducted to determine its quality and storage stability.

REFERENCES

[1] Junji Takano, Health Benefits of Avocado, URL: http://goo.gl/t0Hcis, date retrieved: February 2012

[2] Rachel Sotto, Avocado Production on the Philippines, URL: http://goo.gl/YezBDL, date retrieved: February2012

[3] R. C. Haas, Variations in the Composition of Avocado Seed, URL: http://goo.gl/GnprsM, 1951, date retrieved: February 2012

[4] AOAC. 2011, Official Methods of Analysis International, 18th Edition, Washington DC USA

[5] Olaeta et al (2007). Evolution Of The Content Of Oil And Unsaponifiable Compounds In Hass, Fuerte And Isabel Avocados (Perseaamericana Mill.), Proceedings VI of <World Avocado Congress (Actas VI Congreso Mundial del Aguacate)> November 12-16, 2007, Viña Del Mar, Chile, pp. 1-12

[6] North American Export Grain Association, Wheat and Flour Testing Methods: A Guide to Understanding Wheat and Flour Quality: Version 2, http://www.wheatflourbook.org/doc.aspx?Id=201, date retrieved: September2012

[7] Simsek, S. (n.d.). Wheat Quality & Carboyhydrate Research,https://www.ndsu.edu/ndsu/simsek/wheat/flour.html, date retrieved: September 2012

[8] Braceros, M. R. A. (2011). Determination of Crude fiber of Swift Corned Beef (175g)Using AOAC Official Method 984.04, URL: http://goo.gl/NQxqvC

[9] Husejin, K. et al. (2009).The Importance of Determination of some Physical – Chemical Properties of Wheat and Flour, Agriculturae Conspectus Scientificus, Vol. 74 No. 3 (197-200),pp. 197-200