International Journal of Agriculture Innovations and Research
Volume 3, Issue 6, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 19/04/2015 | Accepted on : 25/04/2015 | Published : 04/05/2015

Vegetable-Added Pasta Noodles: Physico-chemical Composition and Consumer Acceptability

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***Abstract* – Pasta is derived from wheat and shaped into different shapes and sizes. It is rich in carbohydrates, protein, and some essential nutrients making it healthy and an ideal food for the health-conscious consumers. This study determines the consumer acceptability of the three vegetable-added pasta noodles namely: black bean pasta noodles, red bell pepper pasta noodles, and *Gynura procumbens* or sabungai pasta noodles, and its physico-chemical composition. The consumer acceptability was determined using a 9-point hedonic scale with 50 untrained panelists. Results show that the pasta noodles without added vegetables (8.12) is the most acceptable followed by the red bell pepper (7.88), sabungai (7.14)and black bean (6.98) pasta noodle respectively. All pasta noodles were not significantly different in terms of moisture content and ash. The moisture content of sabungai (9.37%) and red bell pepper (9.42%) pasta noodles conformed to the standard, while the other two did not. All ash values (1.04 – 1.18%) are within the standards. The water activity of the pasta with no vegetable-added (0.54) and sabungai (0.55) pasta noodles are not significantly different although both are beyond the standard value for water activity. The black bean (0.48) and red bell pepper (0.49) pasta noodles are also not significantly different but both conformed to the standards of water activity. The no vegetable-added(5.88) and black bean(5.89) pasta noodles were not significantly different in terms of pH unlike the red bell pepper (5.64) and sabungai(5.48) pasta noodles. Still, all types of pasta noodles were within the standard of pH values. All of the pasta noodles are above the fat (2.91 – 4.91%) and protein(13.36 – 15.84%) content standards but below the carbohydrate (66.21 – 72.56%) standard.**

***Keywords* – Black Beans *(Phaseolus vulgaris)*, Red Bell Pepper *(Capsicum annuum)*, *Gynura procumbens*, Pasta Noodles, Physico-Chemical Analysis, Sensory Acceptability.**

I. INTRODUCTION

Alimentary pastes or pastas in Italian refer to a family of macaroni products of various sizes and shapes which remain as one of the popular foods of modern day society (Gatchalian and De Leon, 1992). As a wheat-derived staple food, pasta is second to bread in the world consumption (Gurpreet et al., 2013). It is a carbohydrate-rich food, provides protein with six out of eight amino acids, and contains little to no fat (Wright, 2011). Being a good source of essential nutrients, pastas are often served with cheese and meat sauces which make them all the more nutritious (Gatchalian and De Leon, 1992). A number of pasta recipes have been made using different bases such as tomato, cream and oil. Some pasta recipes also include various types of meat, vegetables and even legumes which all generously add up to the nutritional value of the pasta when consumed.

Consequently, there has been a growing awareness of the connection between diet and diseases, causing consumers to reexamine their diets and seek healthier alternatives. However, fast-paced lifestyles continue to drive the demand for high-quality convenience foods (Hui, 2005) which coincides with the attributes of pasta noodles. Pasta is easy to prepare, has versatile sensory attributes and low cost. It also has a long shelf-life, making it acceptable worldwide (Gurpreet et al., 2013). These characteristics perfectly fit consumer demands on foods that are both healthy and convenient.

In addition, the consumer desire for convenient and more nutritious food and favors the use of natural additives and ingredients (Hui, 2005).

The modern trends in the pasta production coincided with the growing interest on healthier options and led to the production of vegetable-added pasta noodles. The concept of value-added products is also of great interest to food processors, as foods with added value garner higher margins (Hui, 2005).

The addition of vegetables improves the nutritional value of the pasta noodles, and at the same time adds color which makes it more attractive to consumers. A variety of vegetables can be added e.g. Ronzoni (a brand of pasta noodles) offers an enriched carrot, tomato and spinach pasta blend,but in this study, the focus is on red bell pepper *(Capsicum annuum)*, *Gynura procumbens* (sabungai) and black beans *(Phaseolus vulgaris.*

Bell peppers are a part of the nightshade *(Solanaceae)* family. Bell peppers come in many varieties with colors ranging from green to yellow, orange, red and purple, and shapes ranging from round to oblong to tapered. Red bell peppers are given focus in the study since they tend to be sweeter. They also provide a more attractive and vibrant color that will be more appealing to the consumers. It provides an excellent source of carotenoids. It is a rich source of vitamin A, vitamin C, antioxidants and beta-carotene. Aside from being an excellent source of these nutrients, it is also a good source of dietary fiber, phosphorus and niacin (Department of Agriculture, Forestry and Fisheries). Anti-inflammatory and anti-carcinogenic phytonutrients are also present due the high carotene content (Chassy et al., 2006)

Sabungai is a fast growing herbaceous plant (Quisumbing, 1978) that is widely used in Southeast Asia. It is recognized for its hypoglycemic, anti-cancer and anti-diabetic properties, among others (Perry, 1980). It has

been traditionally used as anti-inflammatory topical treatment but it can also be eaten fresh or drank like tea. Studies claim that it has high protein content, anti-hyperglycemic (Hew & Gam, 2010), anti-diabetic (Kim et al., 2006) and anti-oxidative (Puangpronpitag et al., 2010) properties.

Phaseolus vulgaris is the scientific name of common beans such as black beans, pinto beans, navy beans, and kidney beans, which originated in parts of Central and South America (whfoods.com). The bean has a glossy black to dark purple shell and a creamy white interior with an "earthy" and "meaty" flavor (Sinha, 2011). It has the highest amounts of fiber of all beans and contains 59.8% of the recommended daily intake (Coggins and Coggins, 2010). Their soft, mealy texture makes them easy to puree for black bean soup, refried beans, and bean dips (Balch, 2013).

The objective of the study is to determine the physico-chemical composition of the pasta noodles by comparing it to the standards of commercially available pasta noodles in the market. The study also aims to determine the consumer acceptability of the pasta noodles.

II. Materials and Methods

A. Physico-chemical Analysis

The physico-chemical composition of the three types of vegetable-added pasta noodles and the control or no vegetable added pasta noodles was analyzed for moisture content (%MC), ash content, water activity (A_w), pH as well as fat, protein and carbohydrate composition. All conducted analyses for each pasta noodle were done in two trials and the mean value was used.

Moisture Content (%MC) Determination

The moisture content of the four samples was determined through oven-drying method based on AOAC Method 925.10 (2000) in which five grams of the powdered sample was placed in a pre-dried and pre-weighed aluminum dish and placed into a drying oven at 105^0C for two hours. Samples were cooled in a desiccator then weighed. Percent moisture was computed by subtracting the weight of moisture lost in the sample divided by the weight of the sample used multiplied by 100.

Ash Determination

Ash content determination was based on the procedure provided by AOAC Method 923.03 (2000) wherein five grams of powdered sample was placed into a crucible and ignited over a low flame from a bunsen burner. The heat was gradually increased until the sample was completely charred. The charred samples were transferred to the muffle furnace for eight hours at a temperature range between 500-550^0C until a white ash emerged. It was then cooled in a desiccator for fifteen minutes and reweighed. The percentage of ash present in each sample was computed by dividing the weight of the residue in the crucible after ashing over the original weight of the sample before charring multiplied by 100.

Water Activity (A_w) Determination

For the determination of the water activity, the researchers used the brand Sartorius Omnimark: ms1 Portable Water Activity Meter, which is a hand-held instrument that uses direct measurement of relative humidity for precise results. The procedure was based on the AOAC (2012) standards. Each sample was pulverized and weighed to obtain approximately five grams. Samples were placed into the sample cup and a sensor determines the water activity of each sample.

pH Determination

The researchers used a pH meter based on the standard procedure provided by AOAC Method 940.23 (2000) wherein 10 grams of each pasta noodle was weighed and homogenized with 100 ml of distilled water using a blender. The mixture was filtered to prevent lumps that can interfere with the precision of results and placed into a 250 ml beaker. The pH of each sample was determined using a pH meter standardized by a buffer solution of pH 7.

Fat Determination

Fat content was determined by the Soxhlet extraction based on AOAC Method 923.05 (2000), wherein five grams of sample was placed in a double filter paper into the drying oven for two hours. After the samples have been cooled and weighed, it was placed on the extraction thimble. 60 ml of petroleum ether and boiling chips was placed in the extract collecting vessel. The Soxhlet apparatus was turned on with the following parameters: immersion time of 30 minutes, washing time of 60 minutes and recovery time of 30 minutes. The amount of fat by percentage was calculated by dividing the weight of the fat collected from the sample after extraction divided by the weight of the sample before extraction multiplied by 100.

Protein Determination

The researchers based the protein content determination on the Kjeldahl method bases on AOAC Method 930.25 (2000). Five grams of sample was placed in a digestion tube together with boiling chips, 7 grams of anhydrous potassium Sulphate, 0.35 grams of red Mercuric Oxide, 10 ml of concentrated Sulphuric acid and 10 ml of Hyrdogen Peroxide and placed in the digestion thermoreactor at 420^0C until the mixture was white in color. After digestion, the tube was placed in the steam distilling unit with the given parameters of: SP=260^0C, water = 50 ml, Boric Acid = 25ml, Sodium Hydroxide = 70 ml, ditillation time = 2 minutes and steam = 100%. Collect 100 ml of the distillate and add 10 drops of methyl red indicator and titrate with 0.2 N Hydrochloric Acid until endpoint. The protein content odf each sample was determined by multiplying the percent Nitrogen by 6.25. Nitrogen percentage was computed by multiplying the value of titrant used by 1.4007 divided by the weight of the sample.

Carbohydrate Determination

The carbohydrate content of the pasta noodles was determined through Pearson's formula (1976). The mean percentage of moisture, fat, ash and protein content of each sample was summed up then subtracted from 100 to acquire the value of carbohydrate content in each sample.

B. Sensory Evaluation

To determine the consumer acceptability of the three types of vegetable-added pasta and regular pasta noodle with no added vegetable, a sensory evaluation was conducted by 50 untrained panelists. All in all, four coded samples, weighing approximately 10 grams each, were given to each panelist one after the other to avoid biased evaluation. Each pasta noodle was evaluated based on appearance, color, aroma, flavor, texture and general acceptability using a 9-point hedonic scale.

C. Statistical Analysis

The results of the sensory evaluation were interpreted and computed using standard deviation. The difference in chemical composition among different vegetable-added pasta noodles was determined using One-way Analysis of Variance (ANOVA) and Duncan Multiple Range Test (DMRT) comparison.

III. Results and Discussion

A. Physico-chemical Analysis

The vegetable-added pasta noodles were not significantly different from each other in terms of moisture content and ash content. Significant differences in the water activity, pH, protein, fat, and carbohydrate among the different pasta noodles are possibly caused by the raw materials used in each variation.

Table I: Physico-chemical Composition of the Different Vegetable-Added Pasta Noodles.

Physico-chemical composition	Pasta			
	No vegetable added	Black bean	Red bell pepper	Sabungai
Water Activity[1]	$0.54^{a} \pm 0.04$	$0.48^{b} \pm 0.02$	$0.49^{b} \pm 0.02$	$0.55^{a} \pm 0.02$
Moisture Content (%)[2]	$12.83^{a} \pm 0.55$	$11.98^{a} \pm 2.03$	$9.42^{a} \pm 0.27$	$9.37^{a} \pm 0.67$
pH[3]	$5.88^{a} \pm 0.04$	$5.89^{a} \pm 0.02$	$5.64^{b} \pm 0.03$	$5.48^{c} \pm 0.04$
Ash (%)[4]	$1.04^{a} \pm 0.04$	$1.16^{a} \pm 0.02$	$1.18^{a} \pm 0.01$	$1.09^{a} \pm 0.14$
Protein (%)[5]	$14.01^{a} \pm 0.13$	$15.84^{b} \pm 0.21$	$13.93^{a} \pm 0.05$	$13.36^{c} \pm 0.19$
Fat (%)[6]	$4.91^{a} \pm 0.27$	$4.83^{a} \pm 0.28$	$2.91^{c} \pm 0.40$	$4.17^{b} \pm 0.33$
Carbohy -drate(%)[7]	$67.22^{b} \pm 0.46$	$66.21^{b} \pm 2.10$	$72.56^{a} \pm 0.17$	$72.01^{a} \pm 0.95$

Means followed by the same letter are not significantly different from each other at 5% DMRT.
[1]Water activity standard: 0.50 (Coultrate, 2009)
[2]Moisture content standard: 11% (Robertson, 2013)
[3]pH standard: 3.9-5.9 (Preedy et al., 2013)
[4]Ash standard: 1.3% (British Pasta Products Assoc., 2001)
[5]Protein standard: 12% (Ridgewell, 1996)
[6]Fat standard: 1.5% (Robertson, 2013)
[7]Carbohydrate standard: 80.4% (Nielsen, 2010)

The water activity standard for dried pasta noodles is 0.50 (Coultrate, 2009). Comparing it to the vegetable-added pasta noodles, the black bean (0.48) and red bell pepper (0.49) pasta noodles are within the standard while the no vegetable-added (0.54) pasta noodles and sabungai (0.55)pasta noodles fall below the standard. The standard of 0.50 is limited to dried pastas without added vegetables, so it could have caused the non-conformity of the sabungai pasta noodles. The moisture content, though inadequate to determine the stability of the product, can still affect the water activity since water can participate in the different biochemical reactions that is happening in the food product (Labuza, 1997).Therefore, it is possible that the water activity is somewhat high because of the moisture content of the raw materials used. The maximum moisture content of dry pasta noodles would be 11% (Robertson, 2013). Pasta noodles with red bell pepper and sabungai were within the allowable level of moisture, then the no vegetable-added and black bean pasta noodles were not able to conform to the standard. The pH range of the tested pasta noodles is around 5.4-5.9. This value, when compared to the pH of commercially available pastas, indicates no significant difference, since the standard pH is 3.9-5.9 (Preedy et al., 2013). The ash content of the pasta noodles were not significantly different from each other and conformed to the standards because the maximum ash content for pasta noodles is 1.3% (British Pasta Products Association, 2001).

The protein content of the different vegetable-added pasta noodles ranges from 13 to 15%. The usual amount of protein found in dried pasta noodles is 12% (Ridgewell, 1996). The sabungai pasta noodles have the lowest protein content while black bean pasta noodles have the highest. Black beans are rich sources of protein, which explains the high protein content of the black bean pasta noodles among others. The use of Isolated Soy Protein (ISP) in producing the different pasta noodles also explains the slightly higher amount of protein when compared to the commercially available pastas.

The fat content of commercial pasta noodles is usually at 1.5% (Robertson, 2013). However, the fat content of the pasta noodles is higher than the standard, with a percentage ranging from 4 - 5%. On the other hand, red bell pepper pasta noodle has the lowest fat content with a value of 2.91%. This may be due to the low fat content of the red bell pepper. As for the other pasta noodles, the oil

used to improve the consistency of the pasta dough during its production and the fat naturally present in the vegetable are the factors that contributed to the increase in fat content. On the other hand, the fat content of the control also falls within 4 - 5 % even without any vegetable to contribute to the fat aside from the oil used. This is because the amount of oil used in the control is higher compared to the amount of oil used in the three vegetable-added pasta noodles.

The carbohydrate content of the different vegetable-added pasta noodles ranges from 66-73%. But the usual carbohydrate found in commercially available pasta noodles is 80.4% (Nielsen, 2010). The possible reason for the non-conformance is that the flour used was different from the flour used by the commercially available pasta noodles.

B. Sensory Analysis.

Pasta noodles having no vegetable-added pasta noodles have the highest mean scores in all the attributes, red bell pepper pasta noodles came in second, third was the sabungai pasta noodles, and black bean pasta noodles had the lowest sensory score. The acceptability of the pasta noodles with no vegetable-added to red bell pepper is not significantly different but is significantly different from sabungai and black bean pasta noodles. On the other hand, sabungai is significantly different with black beans in terms of appearance, color and texture but not significantly different on the remaining attributes.

Table II: Consumer Sensory Acceptability of the Different Vegetable-Added Pasta Noodles.

Attribute	Pasta			
	No vegetable added	Red bell pepper	Sabungai	Black bean
Appearance	$8.02^{a} \pm 1.06$	$7.84^{a} \pm 1.04$	$6.82^{b} \pm 1.51$	$6.46^{c} \pm 1.69$
Color	$8.02^{a} \pm 1.02$	$8.00^{a} \pm 1.09$	$6.78^{b} \pm 1.43$	$6.40^{c} \pm 1.75$
Aroma	$7.92^{a} \pm 0.97$	$7.82^{a} \pm 1.02$	$7.42^{b} \pm 1.18$	$7.28^{b} \pm 1.50$
Flavor	$8.16^{a} \pm 0.87$	$7.84^{a} \pm 1.30$	$7.16^{b} \pm 1.61$	$7.12^{b} \pm 1.65$
Texture	$7.82^{a} \pm 0.98$	$7.82^{a} \pm 0.80$	$7.36^{b} \pm 1.34$	$6.90^{c} \pm 1.76$
General Acceptability	$8.12^{a} \pm 0.80$	$7.88^{a} \pm 0.87$	$7.14^{b} \pm 1.25$	$6.98^{b} \pm 1.64$

Means followed by the same letter are not significantly different from each other at 5% DMRT.

IV. Conclusion

A physico-chemical analysis was conducted to determine the process needed for each type of food product. It is also important to determine how to lengthen the shelf life of the commodity. The pH and ash values of the pasta noodles conformed to the standard. These results will make it easier for the researchers to determine what needs to be changed or altered in order to conform to the standard values and in turn, produce an acceptable food commodity. The amount of protein of the pasta noodles is higher than the protein content of commercial pasta. This fulfilled the goal to enhance the nutritional value of pasta noodles and make it more appealing and beneficial to the consumers.

In most food products, sensory acceptability is an important indicator of whether the product can be mass-produced and sold to the market. Even though the products obtained tolerable results, this indicated that out of all the four products, the black bean pasta is the least acceptable to the consumers. The results of the sensory analysis will allow the researchers to determine the process and alterations that must be done in order for all the products to be feasible and acceptable to the consumers.

Recommendation

The water activity of non-vegetable added pasta noodles and sabungai pasta noodles are slightly beyond the standard. The pasta noodles with no vegetable-added and black bean did not conform to the standard moisture content. The initial moisture content of added vegetables may have been the cause of the non-conformity of some of the vegetable pasta noodles; it is recommended to alter the amount of water added during the production process or, the rate of dehydration during the drying process in order to achieve the appropriate values. The fat content of the pasta noodles produced are slightly higher compared to that of the standard value of fat content of pastas produced commercially. Since this may be due to the type of oil used in the production process, it is suggested to modify the type and amount of oil used to conform to the standard value. On the other hand, the carbohydrate content of the produced pasta noodles is slightly lower than that of the standard. It is recommended to adjust the amount of flour used in order to conform to the standard most especially since most consumers treat pasta as their major carbohydrate source during their meals.

Pasta noodle with no vegetable-added pasta had the highest mean score values for consumer acceptability in all the attributes followed by the pasta noodles with red bell pepper, sabungai and black bean respectively. Adjusting the amount of vegetable added especially the black bean which seemed to be the least acceptable for consumers will help in increasing its consumer acceptability.

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