Development and Acceptability of Nutribar With Gynura procumbens Powder

Maylen G. Eroa, Engelica C. De Castro, Noemi B. Lajara, and Mark Adrian H. Mondala
College of Industrial Technology
Batangas State University, Pablo Borbon Main II, Alangilan, Batangas City, Philippines
Corresponding Author Email: milesgen@yahoo.com/mileseroa@gmail.com

ABSTRACT

The Philippines is rich in medicinal plants. One of these is the herb *Gynura procumbens* which is known to contain amino acids, carotenoids, alkaloids and many essential oils which are bioactive elements that have a wide range of therapeutic applications. The herb also contains anticancer properties and while it is available locally, it is often disregarded by people especially those who are not aware of its nutritional benefits. This study aimed to develop a nutribar with powdered *Gynura procumbens* and determine its general acceptability. Specifically, it sought to determine the physical properties and characteristics of *Gynura procumbens* plant, the organoleptic properties and the levels of acceptability of the developed *Gynura procumbens* nutribar from varied proportions of *Gynura procumbens* powder, and the physico-chemical properties and nutrient contents of the identified best formulation of nutribar. The researchers used experimental research approach to develop the nutribar with *Gynura procumbens* powder and descriptive-evaluative approach to determine its organoleptic properties and acceptability. Physico-chemical and nutrient analyses were conducted to determine physical and chemical properties of the nutribar while, a nine-point hedonic scale was specifically used to determine the level of acceptability of the various formulations of nutribar. Three formulations of nutribar, Treatment A (w/25% *Gynura* powder), Treatment B (w/50% *Gynura* powder) and Treatment C (w/100% *Gynura* powder), were prepared and evaluated in this study. Based on the sensory analysis, the formulation with 25% *Gynura procumbens* powder (Treatment A) had the highest rate of acceptability in terms of appearance, aroma, texture and taste. All formulations were described Liked Moderately by the respondents. Results of the study also showed that the physico-chemical properties of nutribar with *Gynura procumbens* powder in terms of moisture, ash, crude protein, crude fiber, crude fat and nitrogen free extract were 7.24%, 1.32 %, 5.35%, 2.45%, 13.71% and 69.93% respectively. The nutrient analysis yielded the following results; Carbohydrates, 72.38 g/100g, Iron 48.41 mg/kg, Potassium, 3534.01 mg/kg and Vitamin A, 3.0 IU/g. Conclusively the developed nutribar with *Gynura procumbens* powder contains essential nutrients and has a high potential of being introduced to the market.

Keywords: *gynura procumbens,* nutribar, physico-chemical properties, organoleptic properties, sensory evaluation

1. INTRODUCTION

Food is undoubtedly the most important commodity of the world. It is so valuable for it dictates an individual's health status or condition. However, a lot of people are not critical about the nutritional content of the food they take which often results to misinformation which then leads to malnutrition and/ or over nutrition.

Food innovation has become a common trend in the world today. Food scientists search for new ways to develop food which is nutritious, safe to eat and appealing to the public. The ever-growing world population and the increasing demand for supplemental foods are pressing food scientists to look for ways to utilize the often disregarded nutritious and edible plants for food.

The Philippines is rich in medicinal plants and herbs. Their medicinal benefits are proven and used over a very long time throughout recorded history. Among these is *Gynuraprocumbens* sometimes called "longevity spinach" which can also be found in other parts of Southeast Asia and Africa. *Gynura* locally known as *Sabungai*, is an edible vine with ovate-elliptic or lanceolate shape. It is 3.55 to 8 centimeters long and widens up to 0.8-3.5 centimeters. It grows wild but is also cultivated as a vegetable or medicinal plant. Its young leaves are used for cooking such as with meat and prawns in a vegetable soup [1]. It is often mistakenly identified as Ashitaba (*Angelica keiskei*) which is a species from Japan, which is also a medicinal plant but contains more of anti-diabetic properties.

Gynuraprocumbens is also known as the

wonder plant, anti-cholesterol plant and longevity spinach. It is used as anti-hypertensive, glucose lowering, anti-inflammatory and source of proteins and peroxidase. This plant is widely recognized for its medicinal value. Research shows that it is an efficient regulator of blood sugar and protects the kidney and retinas from damage caused by high blood sugar. It also lowers blood cholesterol and triglycerides, lowers blood pressure and has anti-inflammatory and antiviral activity. The leaves of this plant can be eaten raw or can be used as vegetable. Most recommend 3-6 leaves to be eaten daily. It likes moist soil always. It is easily propagated by cutting stems. *Gynura* is generally accepted as safe. There is no warning or evidence of interaction with drugs.

Research shows that *Gynura procumbens* lowers blood glucose levels and can be used as an effective remedy against diabetes. Its leaf extract has bio-active constituents that ensure anti-diabetic action extracted from this control abnormal cellular growth, *Gynura procumbens* has efficacy in speeding up wound injury as research shows. Adding the leaf extract of this plant in supplement aids in scar forming and wound healing. It also adjusts the growth of lymphocytes or white blood cells in the body thus modulates immune system. It also has anti-inflammatory properties because it contains steroids. It is also a natural skin treatment. It checks skin cells proliferation and warding off any possibility of skin cancer [2].

According to the study[3], *Gynura procumbens* is a good protein source and that may have positive effects on free radical scavenging and iron chelating which may be used as preliminary information and developed further to be commercially useful in food industry or health products as medicinal food.

In recent years, the nutrition-bar market has repositioned itself; low-carb and high-protein trends have been replaced by fiber and nutraceuticals. Nutribars are said to be a better option for supplementing antioxidant for the athletes [4].The ingredient portfolio for bar formulators includes soy- and whey-protein combinations, dietary fiber, plant sterols, isoflavones and vitamin E. Regardless of the bar type, several factors are crucial in bar development: protein source, sweetener type, fiber source, oil, emulsifier system, vitamins and minerals, nutraceutical options and flavor system.

Vitamin and mineral blends and nutraceutical ingredients are premium ingredients that add appeal and promote overall health and wellbeing. Most nutrition bars are fortified with customized blends of vitamins and minerals such as calcium, iron, vitamin D and vitamin E added to achieve 30 to 35 per cent of the recommended dietary allowance. Vitamins and minerals are also inherent in some of the ingredients in the formulation, such as added protein, fruit pieces and nuts [5].

Individual nutraceutical ingredients boost appeal for target consumers. For example, isoflavones and calcium are staple additives to nutrition bars promoting women's health as they can ease the transition through menopause, reducing symptoms such as hot flashes. They may benefit the cardiovascular system by helping to maintain healthy arteries .Some studies also indicate that isoflavones can have a positive effect on skin health.

Plant sterols are increasingly used as nutraceutical ingredients. Sterols naturally occur in vegetables and vegetable oils, in various quantities. They are waxy in nature and insoluble in water. Nutrition bars have minimal moisture, mainly contributed by the ingredients used to formulate them. Therefore, nutrition bars are excellent vehicles for formulating with plant sterols. During processing, sterols can be easily mixed with the dry-ingredients portion of the nutrition-bar system. Nutrition bars can easily be fortified with 400mg, the minimum required by the FDA health claim centered on plant sterols.

The *Gynura procumbens* plant, besides containing a lot of nutrients and medicinal properties, is not at all popular in the Philippines. Most would often treat it as grass without realizing the many nutritional and medicinal properties it has. The researchers came up with an idea of a food product that contains all the necessary nutrients needed by the body in the form of nutribar and has an ingredient that is not popular with the masses but is rich in nutrients and contains medicinal properties, and is at the same time, convenient to eat and easy to transport especially in times of disaster relief operations. The developed *Gynura procumbens* flavored nutribar is formulated to supply the major nutrients needed by the body such as carbohydrates, protein, vitamins and fiber.

Objectives of the Study

The main purpose of the study is to formulate a nutribar with *Gynura procumbens* powder which may also serve as a disaster relief food. Specifically, the study aimed to: (1) determine the properties and characteristics of *Gynura procumbens* in terms of appearance, aroma, taste and texture; (2) evaluate the organoleptic properties of the formulated *Gynura procumbens* nutribar from varied proportions of *Gynura* powder, (a) 25% *Gynura* powder, (b) 50% *Gynura* powder and (c) 100% *Gynura* powder; (3) determine the level of acceptability of the different proportions of *Gynura procumbens* flavored nutribar; (4) determine any significant difference on the level of acceptability among evaluation of the sensory panel of the different proportions of *Gynura procumbens* flavored nutribar; and (5) determine the proximate chemical properties and nutrient contents of the identified best formulation of *Gynura procumbens* nutribar.

2. MATERIALS AND METHODS

The researchers used experimental and descriptive research approaches to develop nutribar with *Gynura procumbens* powder and determine its acceptability. The experimental method was employed in the production of different formulations of a nutribar formulated as a disaster relief food and in the proximate chemical analysis of the identified best formulation.

On the other hand, the descriptive method was used in order to evaluate the produced nutribar. The acceptability of the *Gynura procumbens* flavored Nutribar was determined in terms of color, taste, appearance, mouth feel and aroma. Significant differences on the levels of acceptability as responded to the sensory panel were statistically analyzed using Analysis of Variance (ANOVA).

The *Gynura procumbens* leaves were plants from the garden of the researchers grown ahead of the project development. Other raw materials were Malunggay powder rice crispies, brown sugar, vanilla extract and butter. Uncooked peanuts and pure wild honey were also used. Green bananas were sliced into thin pieces and oven-dried.

Rice crispies comprised the large part of the nutribar; it was the major ingredient in the product. The *Gynura procumbens* powder served as the flavoring and a source of medicinal properties along with the banana and malunggay powders. The aromatic and strong leafy taste of *Gynura* served as perfect as flavoring of the product while honey, butter and brown sugar mixture served as the binding and sweetening ingredients. Peanut was also a major ingredient and added nutritional property to the product.

The procedure in preparing nutribar with *Gynura procumbens* powder was based on the recipe for homemade granola bar which is widely and commonly used. This served as the researcher's guide in preparation of the product.

Table 1

Ingredients used in developing nutribar with

Ingredients
Gynuraprocumbens powder
Malunggay powder
Green Banana powder
Rice Crispies
Peanut
Honey
Brown Sugar
Vanilla Extract
Butter

Table 1 shows the raw materials used in the production of nutribar. *Gynura procumbens* flavored Nutribar is from several local ingredients. The *Gynuraprocumbens* powder was from fresh leaves of *Gynuraprocumbens,* an herb containing anti-hypertensive, anti-oxidant and other medicinal properties [2]. The amount of this powder varied in three formulations.

Preparation of *Gynuraprocumbens* Powder

Figure 1. Preparation of *Gynuraprocumbens* Powder

The *Gynuraprocumbens* leaves were first washed in clean running water to remove dirt and contaminants. These were then drained and air-dried for 10 minutes to remove excess water after which the

leaves were oven-dried for 15 minutes at 150^{0}C temperature setting.

After the oven-drying, the researchers powdered the *Gynura* leaves using sterilized mortar and pestle to reduce the dried leaves into fine particles. The researchers obtained 30 grams of Gynura powder from 100 leaves of *Gynuraprocumbens.*

Preparation of Green Banana Powder

Figure 2. Preparation of Green Banana Powder

Unripe or green bananas were peeled and rinsed in citric acid solution to prevent discoloration. The peeled bananas were sliced thinly and rinsed again in citric acid solution and oven-dried. The banana slices were dried at 150^{o}C for 40 minutes. After drying, the banana slices were reduced to powder using a blender. The green banana powder was added to the nutribar as a binding agent and a source of potassium and other nutrients.

Formulation of Nutribar with *Gynuraprocumbens* powder

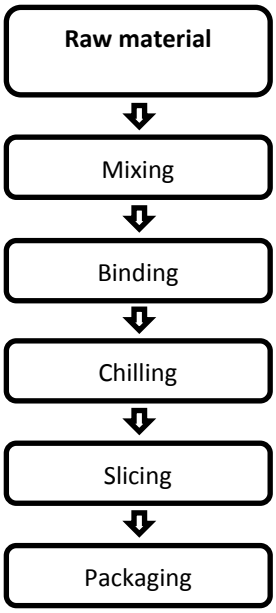

Figure 3. Formulation of *Gynura procumbens* Nutribar

All the ingredients were mixed in a mixing bowl using a wooden spoon. Binding of the ingredients was made using honey and brown sugar. In a pan, the butter was melted then sugar was added until it dissolved. The honey was then added to the binding mixture. The rice crispies, banana powder, malunggay and *Gynura* powder were mixed in a bowl with the binding mixture, after which it was placed and flattened in a 9x5 inch baking pan with parchment paper. The mixture was flattened to ensure firm mold in the baking pan. The molded mixture was set aside to cool for 10 minutes and then chilled for at least 2 hours. Finally, the refrigerated mixture was sliced into bars and stored in an airtight container.

Sensory Evaluation

The researchers made three formulations with varying amount of *Gynuraprocumbens* powder. Treatment A contained ¼ tbsp. or 25% of *Gynura* powder while Treatment B contained ½ tbsp. or 50% of G. Powder: Treatment C had 1 tbsp. or 100% of *Gynura* powder.

The researchers used direct observations, questionnaire and score sheets in the sensory evaluation of the product. A 9- point hedonic scale for sensory evaluation was used to evaluate the various formulations of nutribar with *Gynura procumbens* powder and identify the best formulation.

Fifty panelist composed of 5 trained panelists, experts from the related field, 45 untrained panelists who were randomly select students and 10 faculty members and staff of Batangas State University Main I and Main II Campuses. They were asked to evaluate the organoleptic properties of the prepared nutribar.

Each panelist was given a set of three formulations, Treatments A, B and C and were asked to indicate their rating on appearance, aroma, texture, taste and general acceptability using 9 Point Scale. The results obtained in the sensory evaluation were subjected to statistical analysis.

Proximate Chemical and Nutrient Analysis

The identified best formulation was brought to an accredited chemical laboratory to an determine its proximate chemical content and other nutrient contents. The proximate analysis was for moisture, ash, crude protein, crude fiber, crude fat and nitrogen

free extract. Kjeldahl method was used to obtain the crude protein percentage. Iron, potassium and vitamin A content of the *Gynura procumbens* nutribar were also obtained in the analysis. Atomic absorption spectrophotometric method was used to get the iron content and HPLC method for vitamin A (retinyl acetate) content. (The AOAC Official Methods of Analysis, 17th Edition, 2002.)

3. RESULTS AND DISCUSSION

Physical Properties and Characteristics of *Gynura procumbens*

On physical characteristics of fresh *Gynuraprocumbens* (Figure 5), the leaves are oval-shaped, green, and succulent. The shape of leaves can vary depending on the growing conditions and can range from roundish to ovate in shape but are all shallowly toothed at the margins. *Gynuraprocumbens* leaves have light leafy aroma but when dried, the produce strong leafy aroma. The leaves have a mild raw taste which makes it quite easy to consume. The

Properties and Characteristics of

fleshy leaves are rough to touch.

Figure 5. The *Gynura procumbens* Plant

Organoleptic Properties of *Gynuraprocumbens* nutribar from varied proportions of *Gynura* powder

The three developed formulations of *Gynuraprocumbens* nutribar as shown in Figure 6 were carefully evaluated and analyzed by the researchers and the panel of evaluators for their organoleptic properties.

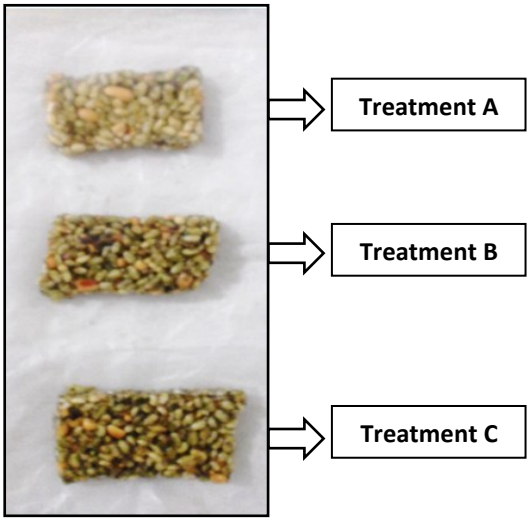

Figure 6. The three formulations of *Gynura procumbens* flavoured nutribar

Table 2 shows the organoleptic properties of *Gynura procumbens* nutribar from the varied

Table2

Organoleptic properties *of Gynura procumbens* nutribar from varied proportions of *Gynura procumbens* powder

ORGANOLEPTIC PROPERTIES				
FORMULATION	**Color**	**Aroma**	**Taste**	**Mount Feel**
TREATMENT A	Light Green	Sweet	Sweet with mild leafy taste	Compact and crunchy
TREATMENT B	Green	Sweet with mild leafy aroma	Sweet with moderate leafy taste	Less compact and chewy
TREATMENT C	Dark Green	Sweet with strong leafy aroma	Sweet with strong leafy taste	Less compact and less chewy

proportions of *Gynura procumbens* powder.

The three treatments differed in the color, aroma, taste and mouth feel. The color of the three treatments varied as the amount of *Gynura* powder increased. The formulation became greener in every addition of *Gynura* powder in the treatment. In terms of aroma, treatment A had sweet aroma due to the honey, butter and brown sugar mixture and as the formulation contained higher amount of

Gynuraprocumbens powder, the leafy aroma became stronger.

As to taste, the leafy taste also increased; however, in terms of texture, the stability of the product decreased from Treatment A to Treatment C. In Treatment A, the product was firm and chewy but the product became less firm as the amount of *Gynura* powder increased.

Level of Acceptability of Nutribar with Varied Proportions of Gynura *procumbens* Powder

The over-all level of acceptability of nutribar with varying proportions of *Gynura procumbens* powder is shown in Table 3.

Table 3. Acceptability of different formulations of *Gynura procumbens* nutribar

Treatment	Weighted Mean	Verbal Interpretation
A (25%)	7.43	Like Moderately
B (50%)	6.98	Like Moderately
C (100%)	6.81	Like Moderately

All of the formulation were moderately liked by the sensory panelists. However, Treatment A had highest rating of 7.43 and thus was identified as best formulation Treatment A was visually described to be green and had sweet aroma. It was also described a sweet with the mild leaf taste and had compact and chewy texture.

Significant difference in the Level of Acceptability of Varying *Gynura procumbens* Proportions

As shown in Table 4, here were no significant differences on the level of acceptability of the *Gynura* nutribar considering its organoleptic properties of color, taste and mouth feel as reflected in p-values ranging from 0.085—.403 which were greater than the 0.05 level of significance. Thus null hypothesis was not registered.

However, significant difference on the assessment on the organoleptic property on aroma of the product nutribar was noted as indicated in p-value of 0.036 which is less than 0.05, thus the rejection of the null hypothesis. As to general acceptability of the nutribar, the sensory panels differ significantly in their evaluation as exhibited in p-value of 0.045 which is lower than the 0.05 level of significance . The null hypothesis was rejected.

Table 4
Difference on the levels of Acceptability from Varying *Gynura procumbens* Proportions

Organoleptic Properties	p-value	F-value	Decision on Ho	Verbal Interpretation
COLOR	0.403	0.914	Accept	Not significant
AROMA	0.036	3.392*	Reject	Significant
TASTE	0.085	2.511	Accept	Not Significant
MOUTH FEEL	0.154	1.898	Accept	Not Significant
General Acceptability	0.045	3.160*	Reject	Significant

***Significant, p < 0.05**

Physico-chemical properties and Nutrient content of the identified best formulation of Nutribar

Table 5 shows the chemical contents and nutrients of 100 gram *Gynura procumbens* flavored nutribar having 25% of *Gynura procumbens* powder (Treatment A.)

Table 5
Proximate Chemical and Nutrient Analysis of the Best Formulation of *Gynura procumbens* Nutribar

PARAMETER	AVERAGE
Calories Cal/100g	434.31
Moisture, %	7.24
Ash, %	1.32
Crude Protein, %	5.35
Crude Fiber, %	2.45
Crude Fat, %	13.71
Carbohydrates g/100g	72.38
Nitrogen Free Extract, %	69.93
Iron (Fe), mg/kg	48.41
Potassium (K), mg/kg	3,534.01
Vitamin A IU/g	3.00

The *Gynura procumbens* had 1.39% ash is a measure of the total amount of minerals present within a food, whereas the mineral content is a measure of the amount of specific inorganic components present within a food. Determination of the ash and mineral content of food is important for nutritional labeling and quality of the product as the quality of many foods depends on the concentration and type of minerals they contain, including their taste, appearance, texture and stability. High mineral contents are sometimes used to retard the growth of certain microorganisms. It is also important to know the mineral content of foods during processing because this affects the physicochemical properties of food. [8].

Moisture content influences the taste, texture, weight, appearance, and shelf life of foodstuffs. Substances which are too dry could affect the consistency of the end product. Conversely, the rate of microbial growth increases with total water content, possibly resulting in spoiled batches that need to be disposed of[8]**.** In the analysis result, the moisture content was 7.24%. Treatment A also had 13.71% crude fat and 5.35 % crude protein. The crude protein (CP) content was calculated from the nitrogen content of the food, determined by a modification of a technique originally devised by Kjeldahl. In this method, the food is digested with sulfuric acid, which converts to ammonia all nitrogen present except that in the form of nitrate and nitrite.

On the other hand, the carbohydrate of the food is was categorized in two fractions, crude fibre (CF) and the nitrogen-free extractives (NFE). The former was determined by subjecting the residual food from ether extraction to successive treatments with boiling acid and alkali of defined concentration; the organic residue is the crude fiber[7]**.** The produce nutribar had 13.71% of crude fiber and 69.93% nitrogen-free. Iron content was 48.41 mg. Iron is an important mineral in people's diets. Although considered a trace mineral, diets lacking in iron can contribute to some deficiency condition. Potassium is also an important nutrient which primarily regulate fluid balance and controls the electrical activity of the heart and other muscles.

Treatment A had 3,534.01 mg of potassium. According to WHO, potassium intake for adults is 3,510 mg. Treatment A contained 3IU/g of vitamin A, essential for good vision, reproduction and healthy bone growth.

4. CONCLUSIONS

The Study concluded the following:

Gynura procumbens like other medicinal plants and herbs can be recognized from its inherent physical characteristics of appearance, aroma, texture and taste.

The three formulations of *Gynura procumbens* flavored nutribar vary in their organoleptic properties in terms of color, aroma, taste and texture.

All three formulations are liked moderately by sensory panel but the nutribar with 25% *Gynura procumbens* is highest in general acceptability, thus it is considered as the best formulation.

The sensory panel has similar evaluations on the produced nutribar's color, taste and mouth feel but the differ on their evaluation on the products aroma and general acceptability.

The developed nutribar with *Gynura procumbens powder* contains essential nutrients such as protein, fiber, fat, iron, potassium and vitamin A. It has a high potential of being introduced to the market.

5. RECOMMENDATIONS

Based on the results of the study the following were recommended:

1. For a more nutritious and organic product, coco sugar, palm sugar or Stevia sugar can be used instead of brown sugar. Instead of butter, vegetable oil can be used for a healthier product.

2. The appearance of the product may be improved to be more appealing by adding chocolate or other organic flavor

3. Improve packaging for convenient handling of the product.
4. Further study on the microbial and other nutrient analysis as well as the determination of the shelf-life of the product.

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REFERENCES

[1] Y.Tanaka, andV. K., Nguyen .Edible *Wild Plants of Vietnam: The Bountiful Garden*. Thailand: Orchid Press. p. 50.ISBN 9745240893G, 2007.

[2] Hoe S.-Z., Lee C.-N., Mok S.-L., Kamaruddin M. Y., Lam S.-K. *GynuraprocumbensMerr.decreases blood pressure in rats by vasodilatation via inhibition of calcium channels*. Clinics 66, 143–150. 10.1590/S1807-59322011000100025,2011. [Online].Available:http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.293.9291&rep=rep1&type=pdf. [Accessed December 3, 2016]

[3] D. Puangpronpitag, S. Chaichanadee, W. Naowaratwattana, C. Sittiwet, K. Thammasarn, A. Luerang and N. Kaewseejan.*Evaluation of Nutritional Value and Antioxidative Properties of The Medicinal Plant Gynuraprocumbens Extract*. Asian Journal of Plant Sciences, 9: 146-151, 2010.

[4] V. Supriyaand L. Ramaswamy PhD, *Development of an Anti-Oxidant Rich Nutrient Bar for Athletes*Supriya V1 ,International Journal of Science and Research.Vol.3, Issue 9, 2014. [Online].Available:https://www.ijsr.net/archive/v3i9/U0VQMTQ2ODk=.pdf

[5] L. Bradford."8 Vital Ingredients in Nutrition bar Applications", Sep 21, 2009. [Online] Available:www.newhope.com/ingredients/8-vital-ingredients-nutrition-bar-applications. [Accessed January 2, 2017]

[6] Shields and N. Rangarajan. A Playbook for Research Methods: Integrating Conceptual Frameworks and Project Management Paperback , 2013.

[7] K. Dublecz, "Proximate Analysis of Foods", 2011 [Online].Available:http://www.tankonyvtar.hu/en/tartalom/tam-p425/0010_1A_Book_angol_04_takarmanyozastan/ch03.html. [Accessed January 3, 2017]

[8] Y. Appoldt, and G. Raihani,*Moisture Content Determination*.Food Quality and Safety, February 3, 2017. [Online] Available: http://www.foodqualityandsafety.com/article/determining-moisture-content/. [Accessed February 20, 2017]

[9] D.J. McClements. Understanding and Controlling the Microstructure *of Complex Foods*. Woodhead Publishing, Cambridge, UK., 2007.