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Research Paper

Nutritional Composition of Miracle Cereal Finger Millet (*Eleusine coracana*) and its Innovative Product Development

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A B S T R A C T

Finger millet (*Eleusine coracana*) is a fine cereal and a rugged crop, one of the crops that can remain uninfluenced in many terms and conditions. Compared to other cereals the finger millet has high protein, minerals, and iron. Eating finger millet regularly reduces the risk of diabetic mellitus. Amino acid methionine lecithin improves the cholesterol levels by removing excess liver fat, and threonine helps to prevent liver fat disposal. Finger millet incorporation will increase the nutritional value of any diet. Finger millet flour can be added to baked products to formulate calcium and iron enriched cookie cake. The objective of research is to find out nutritional composition of finger millet and to prepared nutritionally incorporated cookie cake by finger millet flour. Calcium deficiency is dominant over the bone and teeth related disorders, and iron prevalence is identified by introducing FM in our diet. In this objective there are three uncommon samples were assigned for recipe standardization. Three different ratios are made 25%, 50% and 75% respectively. It observed that the cookie cake prepared with 50% Finger millet was highly acceptable by sensory analysis. Finger millet flours fortified wheat flour significantly improved the chemical composition (fat, fiber and protein and carbohydrate). According to sensory and nutritional quality, fortification of cookies cake with 50% finger millet flour affect the quality and nutrition of cookie cake in positive way i.e., the carbohydrate content in the cookies cake is resulted 65.63%, protein content is 14.89%, fat content is 13.45% and ash content 1.9%, respectively. By all means the sample 2 with 50% finger millet flour incorporation was found suitable and sample 2 found best one.

***Key words*:** Finger millet flour, Incorporated, Deficiency, Chemical, Sensory attribute

A cereal course is an important part of India's diet for millions of people. Coarse cereal refers to other cereals which Wheat and beans. Finger millet (*Eleusine coracana*) is also present in India. Finger millet (*Eleusine coracana*) is an economically important nutraceutical crop. In local language it is known as the Ragi, Mandua, Nachni or Nagli. The growth of *Eleusine coracana* is mostly occur in arid and semiarid area of Africa and Asia. The main cultivation area of finger millet are hilly areas and southern part of India. Finger millet have well stocked with source of Ca (300-350mg %), Phosphorus (283mg %), Fe (3.9%) [1]. Finger millet is one among the millets that claims to possess antidiabetic potential effect, antiulcerative properties, aids high iron content which favour the anaemia patients and also beneficial for those people who is suffering from low haemoglobin level [2]. Ragi flour will provide many health benefits like ragi for losing weight, bone health, lowering blood cholesterol, and other health conditions. The major ragi cultivating states in India are Maharashtra and Uttaranchal. It gained a lot of importance in recent years because of its higher contents of calcium, iron and dietary fiber. The calcium content is higher than all cereals and also has good quality protein along with the presence of essential amino acids, vitamin B and phosphorus [3]. Thus, it is a good dietary source of nutrients for growing children, expecting women, elderly people and patients. The most common use of Finger millet is the preparation of flour, to make pudding, porridge, roti, cake, idli, biscuits etc. When it's come to awareness of the consumers about the fitness, finger millet is serves as crowd pleasing grain for maintenance of body. As it is gluten free grain which is best for the weight losing very fastly [4]. The factor which is affecting body weight is gluten and the fibre. Finger millet have large amount of fibre which restrict the obesity and provide energy. Along with these properties it also helps in the improvement of digestion. The mixed flour of ragi and wheat develop the nutritional quality along with health benefits [5]. Ragi is called as staple cereal grain due to its cheap rate and economically suitable in the area of low-income group population. Finger millet is better grown in the area having rain fall range between 600-1,2000 mm. The cultivation is better in the acid soil whereas it can also be grown in the low fertile soil and highly weathered tropical lateritic soil [6]. It is the only cereal crop that can also better grown in drought conditions throughout the year. Finger millet is administered as the boon when it is used as a whole grain on account of having protein and minerals in comparison with all other cereals and millets.

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One of the main cereals in the highest region between small millets under cultivation. Finger millet in contrasted with other millet is rich in protein, fats, calcium minerals, phosphorous and dietary fibres. This is high in dietary carbohydrates and is an excellent natural calcium source which helps to improve children's bones and elderly people. It helps to regulate blood sugar levels in a diabetic state. Finger millet based diet was found helps diabetics, since it has higher fibres than rice and wheat. In the south, ragi is favoured because of its high nutritional content. It is a strong natural iron source, which helps in restoring anaemia. Because of their high calcium and iron content, ragi based products are recommended for expectant mothers. Baked products become popular due to their availability, ready to eat convenience and also having long shelf life [7]. It maintains low moisture content as a result of which the microbial spoilage of products can be inhibited. Therefore, the extensive production and distribution of products are made possible. Research to develop new products are due to the demand of consumer for the food which can fulfill sensory quality along with functional and nutritional property. Biscuits are known for delivering bioactive compounds in diet of human being. Some common bakery products are breads, cookies, pastries, muffins, cake, etc. A cookies cake is a baked product made from cookies. It is a dessert of regular size, shape and decorated with frosting. During the preparation of cookies cake firstly cookies dough made.

MATERIALS AND METHODS

The present study is carried out in the Department of food science at Babasaheb Bhimrao Ambedkar University (A Central University), Lucknow. The Material used and methods adopted for the present investigation are presented under suitable heading.

Table 1 Nutritional value

Nutrients	Per 100gm
Energy	336
Total carbohydrate	72.6
Protein	7.7
Fiber	3.6
Fat	1.5
Calcium	344 (mg)
Iron	3.9 (mg)
Niacin	1.1 (mg)
Thiamin	0.42 (mg)
Riboflavin	0.41 (mg)

Source: USDA Nutrient Database (2018)

Finger millet has a strong vitamin / mineral supply, it has large calcium amounts. Calcium is a main ingredient for us. Body needs are about 250-350 mg per day.

Table 2: Finger millet nutritional value (Minerals)

Mineral content	Amount (mg)
Thiamine	0.45
Calcium	355
Riboflavin	0.19
Niacin	1.2
Iron	4.0

Nutritional composition of finger millet

Finger millet (Eleusine coracana) is small in protein, but nutritionally superior due to protein as compared to many cereals. Millets have a higher amount of ash that indicates a strong mineral presence, finger millet is in-rich. This also has the highest calcium content in compared to iron and phosphorus (300-350 grams/100 grams). It has high fibre content and improve digestibility. Another attribute characteristic of millet grains is nutrients. The nutritional components are determined by using the following protocols.

Table 3 Finger millet nutritional value (Amino-Acid)

Amino acids content	Amount (mg/g) per 100 gm
Cystine	165
Lysine	180
Tryptophan	192
Methionine	195
Threonine	260
Isoleucine	274

Proximate analysis

Determination of ash content

Weigh accurately about 5 gm of the sample in a Tared, clean, and dry silica dish difference. Ignite the sample in a dish on the flame of a burner for one hour. Complete the ignition by keeping in, a muffle furnace at 550°C until grey ash results. Cool in desiccators and weigh. Record the observation.

Calculation: Total ash content (on dry basis), percentage by mass: $(M_2 – M) \times 100 \div M_1 – M$

M: Mass in gm of the empty crucible.

M_1: Mass in gm of the dish with the material taken for the test.

M_2: Mass of the crucible with the ash in gm.

Determination of carbohydrate content

The carbohydrate content was determined by the SP:18 test method.

Calculation: Carbohydrate percentage = 100 – (% Moisture content + % Fat content + % Ash content + % Protein content)

Determination of protein

Protein content was determined by Automated Biokjgel (Protein estimation Machine) (IS: 7219:1973 RA 2005). Weigh 0.5 to 1.00 gm test portion into, digestion tube. Add 30 gm potassium sulphate. 0.5 gm anhydrous cupric sulphate Add 10 ml Concentrated H_2SO_4.

Digestion: Place the tube with-rack in the digestion unit and lock the tube with a bioscrub fume neutralizer. Select program 01 and click to start. Adjust the temperature 250°C - 10 min, 300°C - 10 min, 350°C - 10 min, 420°C - 75 min. After Completion of digestion, cool the tube at room temperature.

Automatic distillation: Place the tube into an automatic digestion unit add 40% NaOH 40 ml in the tube and 4% Boric acid 25 ml in the receiver by machine. Select program 01 and distillation will complete in 9 minutes.

Titration (Manually): Remove the receiver flask and add the mix indicator 2-3 drop and titrate with 0.1 N HCl /0.1 N H_2SO_4 endpoint shows pink color. It is proceeded by Kjeldahl's method. Take 2gm of a sample in a Kjeldahl's flask. Add 1-2gm of catalyst mixture. Now keep the flask in protein digester. In this digester chamber, add 5.8ml hydrogen peroxide and 12ml concentrated sulphuric acid. Heat till

mixture boils briskly at °C and the moderate rate at a temperature of 420 color changes to pale blue. Transfer the content to a 100ml flask and place it automatic protein distillation unit. It has a mixture of 35% NaOH, 25ml H_2O, and 4% boric acid. When the flask is placed under the condenser of the distillation unit, nitrogen is obtained as small droplets another conical flask that is collected. Titrate it with 0.2N HCl till faint pink color appears, using methyl red as an indicator. Note down the titration value.

Protein Content = Titration value × Normality of HCL × 6.25 × 2.809 × 100 ÷ Sample weight × 0.2 × 1000

Determination of crude fibre

The crude fibre was determined by gravimetrically after chemical digestion and solubilization of other materials present. The fibre residue weight is then corrected for ash content after ignition IS: 1155: 1968.

% Crude Fibre (dry basis) = Dry residue Wt. (g) Ignited residue Wt. (g) Blank Wt. Loss (g)) × 100 × 100 ÷ Sample Wt. (g) × Sample Moisture, (%)

Determination of fat

Fat was determined by the Soxhlet Extraction apparatus (IS:12711:1989:RA 2005). Weigh accurately about 5 to 10 gm of the dried material sufficient to give about 1.0 g of fat in the suitable thimble and dry for 2 hours at 100 ± 5°C. Place the thimble in the Soxhlet extraction apparatus and extract it with the solvent for about 16 hours. Dry the extract contained in the Soxhlet flask, the empty mass of which has been previously determined by taring at 95°C to 100°C for an hour. Cool in desiccators and weigh. Record the weigh.

Fat content by mass = $100 \times (M_1 - M_2) \div M$

M_1- Mass in gm of the flower flask with the extracted fat.
M_2- Mass in gm of the empty Flower flask clean and dry.
M- Mass of the material (gm) taken for the test.

Calcium, iron, magnesium, and zinc were determined by the standard method using Atomic Absorption Spectrometry (AAS). Test portions are dried and then ashed at 450°C under a gradual increase (about 50°C/hr) in temperature, 6 N HCl (1+1) is added and the solution is evaporated to dryness. The residue is dissolved in 0.1N HNO_3 and the analytes are determined. Reagents: (a) Water - redistilled or deionized. (b) Hydrochloric acid A.R (6N) - Dilute 500 ml HCl to 1 liter with water (c) Nitric Acid A.R 0.1M - dilute 7 ml conc. acid to 1 liter. (d) Nitric acid concentrated (Sp. Grade 1.40) (e) Standard solutions of calcium, iron, magnesium, and zinc prepared as1mg / ml. Dissolve 1.000 gm calcium/iron/ magnesium/ zinc in14 ml water + 7 ml conc HNO_3 in 1 litre volumetric flask and dilute to volume with water. Working Standard solution - For graphite furnace analysis dilute standard solutions with 0.1 M HNO_3 to a range of standards that cover the linear range of the elements to be determined. For Flame, analysis dilutes standard solutions with 0. 1 M HNO_3 to a range of standards that covers the concentration of the elements to be determined.

The moisture content of the sample was determined by the standard method described as Moisture percent by mass = $100 \times (M_1 - M_2) \div M_1 - M$

M_1- Mass in gm, of the dish with the material before drying.
M_2- Mass in gm of the dish with the material after drying.
M- Mass in gm of the empty dish.

Minerals analysis

Calcium: 5ml of sample was added in 2 drops of conc. H_2SO_4 it gives white precipitation which indicates the presence of calcium.

Manganese: 0.5ml of sample solution add 1 ml of 1% KOH solution, add 5 drops of Benzidine reagent, it gives blue color which indicates the presence of manganese.

Phosphorous: 0.5ml of sample solution add 2 drops of ammonium molybdate reagent, it gives yellow color which indicates the presence of phosphorus.

Iron: 0.5ml of sample was added in 3 drops of KSCN reagent, the formation of red color it indicates the presence of iron.

Phytochemical test

The finger millet flour sample phytochemical components were tested using normal protocols.

Terpenoid: 0.1ml of sample was mixed with 0.3ml chloroform and equal volume of concentrated H_2SO_4. It gives reddish brown coloration, indicates presence of terpenoid.

Flavonoids: 0.2 ml of sample was mixed with 2%NaOH and 0.1ml dil. HCl. The colourless solution turning yellow. Indicates presence of flavonoids.

Phenol: 0.1ml of finger millet flour sample was dissolved 0.4 ml of $FeCl_3$ acholic solution. 5 ml of 70% ethanol and 0.1 gm of $FeCl_3$ was added. The presence of yellow colouration. It indicates the absence of phenol.

Glycoside: 0.2 ml of sample was dissolved in equal volume of acetic acid and chloroform. 0.1 ml of H_2So_4 was added. 0.2 ml of sample was dissolved in equal volume of acetic acid and chloroform. 0.1 ml of H_2So_4 was added. It gives reddish-brown colour with few layers changing, the upper is a bluish-green colour which indicates the presence of glycoside.

Saponins: 0.1 ml of sample was dissolved in 1 ml of distilled water and shaken in a cylinder for 15 min, no formation of forth indicates the absence of saponins.

Steroid: 0.1ml sample was dissolved in 0.3ml chloroform and equal volume of concentrated $H_2SO_4$was added on the sides of the test tube. The upper layer turning red and sides of tubes turning green in colour indicates the presence of steroid.

Product development

The different materials required for the product development like wheat flour, ragi flour, sugar, Baking powder, fat were collected from local market Lucknow.

Preparation of cookie cake

Sieve properly the refined wheat flour and Ragi flour separately, and mix them. Powdered sugar added into butter, this process is known as creaming or blending. Then slowly add mixed flour with baking powder. The dough was produced by proper mixing and transfer into mold. And baking them 150°C to 180°C for 15 to 20 min. Then cool these cookie Cake at room temp and then packaging (Fig 1).

Sensory evaluation of cookie cake

Sensory evaluation of the sample was carried out by trained sensory panel member using nine point's hedonic scale. Attributes like taste, color, appearance, flavor and overall acceptability was scored based on its intensity scaled. In this objective 9-Point Hedonic Scale has been used for the sensory evaluation. Evaluated sensory score of the analysis given by the sensory panels are given below in graph.

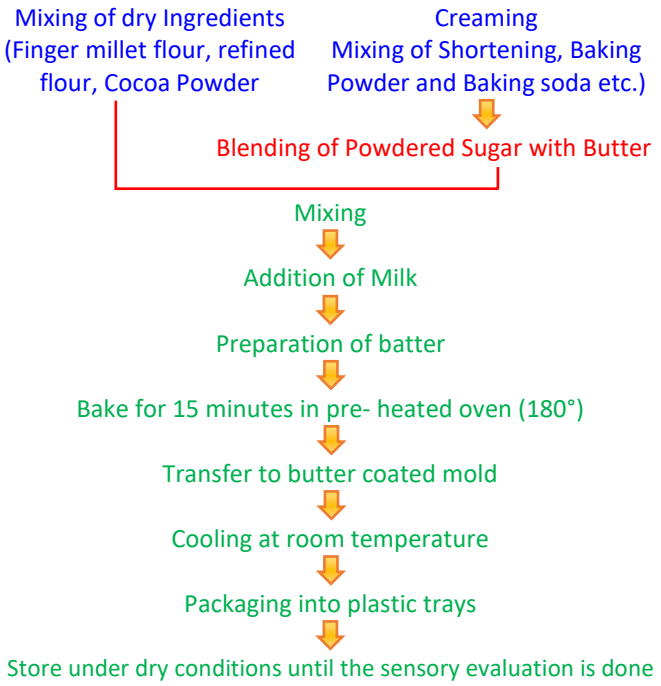

Fig 1 Preparation of cookie-cake

RESULTS AND DISCUSSION

The nutritive value of finger millet flour sample is shown in the table given below:

Table 4 Finger millet nutritional value

Nutrients	Amount per 100 gm
Energy (Kcal)	336
Fat (gm)	1.5
Fibre (gm)	3.6
Protein (gm)	7.7
Carbohydrate (gm)	72.6

The minerals tests of finger millet sample is shown in the table given below:

Table 5 Summary of minerals test in finger millet

Mineral content	Result
Calcium	Present
Manganese	Present
Phosphorus	Present
Iron	Present

The phytochemical tests of finger millet sample is shown in the table given below:

Table 6 Summary of phytochemical test in finger millet

Phytochemicals	Result
Terpenoid	Present
Flavonoid	Present
Phenol	Absent
Glycosides	Present
Saponins	Absent
Steroid	Present

Chemical analysis

The result of chemical analysis is given in (Table 8). Moisture was determined as by method of A.O.A.C. Total protein determination was done by micro Kjeldhal method according to A.O.A.C. The fat content was regulated by the method A.O.A.C. using soxhlet apparatus. Crude fibre determination was regulated by using A.O.A.C. method. For Ash estimation samples were kept in muffle furnace at 550°C for 6 hours.

Table 7 Average sensory score

Sample	Organoleptic score					
	Color	Taste	Flavor	Texture	Appearance	Overall acceptability
Sample 1	7.2	7.0	6.9	7.5	7.2	7.7
Sample 2	7.8	7.5	7.1	7.6	7.2	7.9
Sample 3	7.0	6.5	6.8	7.5	7.3	7.0

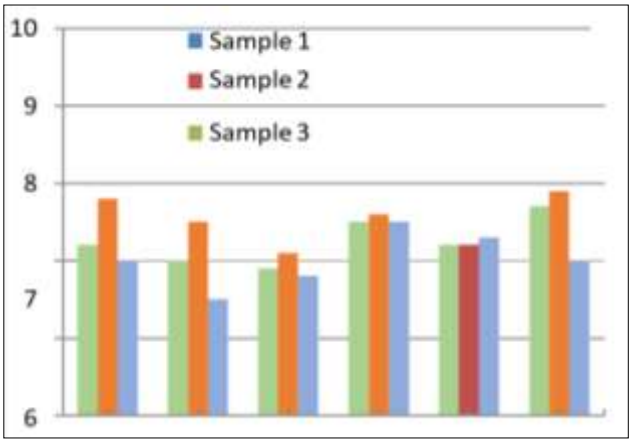

Fig 2 Average sensory analysis data

Table 8 Nutritive value per 100 gm

Parameter	Result
Moisture	11.3%
Ash	1.9%
Fat	13.45 g
Carbohydrates	65.63 g
Protein	14.89 g

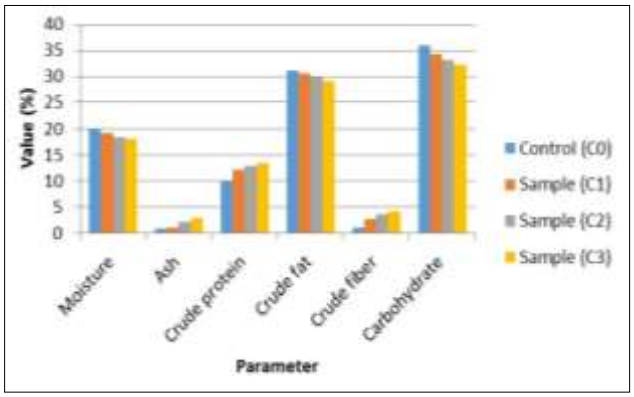

Fig 3 Nutritional evaluation of cake formulated with ragi flour and peanut butter

As the content of butter and finger millet flour is increased in the cake, moisture content of cake is decreased from 20.15%, 19.92%, 19.72% and 19.55% respectively. The

cake sample contain 45% finger millet flour and 30% peanut butter had the lowest in moisture content (19.55%) and cake only prepared with wheat flour and butter high in moisture content (20.15%) [8]. The ash content of cake sample prepared with ragi flour and peanut butter was increased when the incorporation of ragi flour and peanut butter increases 1.47%, 1.54%, 1.67% and 1.87%. 1.87% of ash content is noted in the C_3 cake sample containing 45% finger millet flour and 30% peanut butter which is very high and cake only prepared with wheat flour and butter low in ash content (1.47%). When the incorporation of ragi peanut butter increment was from 12.13%, 12.68%, 12.92%, 13.19% the crude protein content of cake rises. The crude protein content of cake rises. High protein (13.19%) is contained by the cake sample with 45% finger millet flour and 30% peanut butter and low protein (12.13%) is found in the cake sample prepared without ragi flour and peanut butter [9]. When the incorporation of peanut butter increased in order of 30.85%, 30.13%, 29.04%, 28.16% the crude fat content decreased. The cake sample contain 45% finger millet flour and 30% peanut butter contain low amount of fat (28.16). High fat was assigned in the cake which contains 0% peanut butter (30.85%) [10]. The crude fiber content of cake increased with the increase the incorporation of ragi flour and peanut butter (1.13%, 2.03%, 3.15%, 4.13%). High amount of crude fiber is found in the cake having 45% finger millet flour and 30% peanut butter. The cake sample prepared without ragi flour and peanut butter contain low amount of crude fiber (1.13%) [11]. As the peanut butter and finger millet flour increased in the cake sample there is a rapid decrease in the carbohydrate content as 34.27%, 33.7%, 33.5%, 33.1% respectively. The cake sample contain 45% ragi flour and 30% peanut butter contain low amount of carbohydrate (33.1) and cake prepared without ragi flour and peanut butter contain high amount of carbohydrate (34.27) [12]. The incorporation of ragi flour and peanut butter increases the calories value. The high calorific value (462.73) is assigned in the control sample which is without ragi flour and low calorific value is determined in the sample having great amount of ragi flour and peanut butter (429.6).

CONCLUSIONS

The finger millet's dietary fiber and polyphenols have been recognized to offer several health benefits such as anti-diabetic, protection from diet related chronic diseases, hypocholesterolaemic, antioxidants effect to its regular consumption. Moreover, it is likewise rich in calcium, carbohydrates, energy and nutrition. In the present study experiment have been also carried out to find the response of incorporation of Ragi flour on the sensory and nutritional utilities of cookie cake. The result of the analysis and test show that the incorporation of ragi flour 50% is found to be most acceptable to obtain cookie cake with improved nutritional quality and satisfactory sensory attributes. In present study the efforts are made towards the nourishment of cookies cake with ragi flour. So, three different samples were taken for recipe standardization and the ratios are made differently 25%, 50% and 75% respectively. Wheat flour replacement was done with ragi flour. Therefore, these results concluded that in conjunction with ragi flour the fat content of cookie cake is increases significantly. When more than 50% ragi flour is used to replace the wheat flour, the sensory quality and baking process are influenced negatively.

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LITERATURE CITED

1. Chaturvedi R, Srivastava S. 2008. Genotype variations in physical, nutritional and sensory quality of popped grains of amber and dark genotypes offinger millet. *Journal of Food Science and Technology* 45(5): 443-446.
2. Desai AD, Kulkarni SS, Sahu AK, Ranveer RC, Dandge PB. 2010. Effect of supplementation of malted Ragi flour on the nutritional and sensorial quality characteristics of cake. *Advance Journal of Food Science and Technology* 2(1): 67-71.
3. Kulkarni SS, Desai AD, Ranveer RC, Sahoo AK. 2012. Development of nutrient rich noodles by supplementation with malted ragi flour. *International Food Research Journal* 19(1): 309-313.
4. Lakshmi KP, Sumathi S. 2002. Effect of consumption of finger millet on hyperglycemia in non-insulin dependent diabetes mellitus (NIDDM) subjects. *Food Nutrition Bulletin* 23(3): 241-245.
5. Majumder TK, Premavalli KS, Bawa AS. 2006. Effect of puffing on calcium and iron contents of finger millet varieties and their utilization. *Journal of Food Science and Technology* 42(5): 542-545.
6. Mathanghi S, Sudha K. 2012. Functional and phytochemical properties of finger millet (*Eleusine coracana*) for health. *International Journal of Pharmaceutical, Chemical and Biological Sciences* 2(4): 431-438.
7. Shahbaz M, Hanif K, Masood S, Rashid A, Bilal M, Akbar N. 2013. Microbiological safety concern of filled bakery products in Lahore. *Pakistan Journal of Food Science* 23(1): 37-42.
8. Vijayakumar M, Chappalwar, Dayanand P, Bobde H, Steffi M, John. 2013. Quality characteristics of cookies prepared from oats and finger millet based composite flour. *International Journal of Engineering Science and Technology* 3(4): 2250-3498.
9. Pinki A, Pratima A. Sensory and nutritional evaluation of value-added cakes formulated by incorporating beetroot powder. *International Journal of food and Nutritional Sciences* 3(6): 145-148.
10. Sadaf J, Bibi A, Raza S, Waseem K, Jilani M, Ullah G. 2013. Peanut butter incorporation as substitute for shortening in biscuits: Composition and acceptability studies. *International Food Research Journal* 20(5): 3243-3247.
11. Swami SS, Swami SB. 2006. Physical properties of finger millet (*Eleusine coracana*). *International Journal of Agriculture Science* 3: 156-166.
12. Tiwari A and Mishra S. 2019. Nutritive Evaluation of wheat bran biscuits incorporated with flaxseed. *International Journal of Science and Research* 8(9): 1250.