STUDIES ON OPTIMIZATION OF MILLET BASED MUFFINS AND EVALUATION OF ITS PHYSICOCHEMICAL CHARCTERISTICS DURING THE STORAGE PERIOD

ABSTRACT

Millets are excellent source ofprotein, minerals and dietary fibers, and therefore they can be supplemented in bakery products and plays a therapeutic role in human health. The present study is aimed atoptimizing the level of pearl millet, finger millet and little millet flours for preparation of muffins. In the present study, pearl millet, finger millet and little milletflour was used at the rate of 10%, 20% and 10%respectively for treatment S1and for treatment S2, pearl millet, finger millet and little millet flour % was 10%, 15% and 15% respectively. For treatment S3, pearl millet, finger millet and little millet flour content was 10%, 10% and 20% respectively. Control samples were prepared using wheat flour in treatment S0. The standardization of samples weredone based on sensory scores. The results showed that samples of S1 treatment scored highest in color, texture and overall acceptability in organoleptic evaluation. Themoisture, fat, protein, carbohydrate and ash %was found to be 22.20, 18.21, 12.64, 45.23 and 1.94% respectivelyin muffin sample of S1 treatment which was considered as the standardized product. The samples of S1 treatment were subjected to storage studies at room temperature and it was found that the muffin samples remained acceptable upto 60 days of storage.

Keywords: Millets, nutritional profile, muffins, pearl millet, finger millet, little millet, shelf life studies.

1. INTRODUCTION

Muffins are baked products, sweet in nature and highly acceptable by consumeras it has soft texture and characteristic taste**Ramya and Anitha (2020).**Muffins are very popular snack item,

generally made up of wheat flour which is mainly eaten by children. Incorporation of different millet flour, which are good source of minerals, iron, fibers, protein etc. increases the nutritive value of muffins and also increases the acceptability quality of the product.

Millets are small grains and grown on the marginal lands in dry areas in temperate, tropical and tropical regions as grain crops. There are varieties of millets cultivated which includes pearl millet which consists of 40% of the world production, Foxtail millet, Proso millet or white millet and Finger Millet. Millets contains high level of fiber and polyphenols. They reduce several non-communicable disease conditions like cardiovascular disease, diabetes and high blood pressure**(Majumdar et al.,2023)**Consumption of nutritious food is highly essential to lead a healthy life. Millets are known to have enormous nutritive values in comparison to rice and wheat. From ancient times, millets have been used as a staple food in diets of Asian and African people. Millet porridge is the most common traditional food in India, China, Russia, & Germany **(Mishra et al.,2022)**Whole-grain cereals such as brown rice and millets are nutritionally superiortothe widely consumed polished white rice. Studies have also shown that the dietary glycemic load (a measure of both quality and quantity of carbohydrates) and the higher intake of refined grains such as white rice were associated with the risk oftype 2 diabetes and metabolic syndrome among urban south Asian Indians **(Shobhana et al.,2013)**Finger millet *(Eleusine coracana)* which are commonly named as Mandua or Ragi are considered to be rich in micronutrients such as vitamins and minerals as compared to other major cereals, wheat and rice of the world. Especially, finger millet is the richest source of calcium and have 10 times more than wheat, maize and rice and three times greater than milk.**(Jagati et al.,2021)**

According to the studies,little millet is a rich source of good cholesterol, high phosphorous (220 mg/100g) and iron (9.3 mg/100g). Few studies, which can be prepared using little millet are dosa, idli, pongal, kichadi. Millets are staple food source, which are not only providing major nutrients like protein, carbohydrates, fats etc but also provide ample of vitamins and minerals. In developing countries malnutrition and various health problems like obesity, diabetes, cardiovascular diseases, cancer, celiac disease etc are most prominent because of inadequate supply of nutrition.**(Bhat et al.,2018)**

Pearl millet *(Pennisetum glaucum),* also known as bajra, is a rich source in magnesium which helps the cardiovascular system by lowering blood pressure, which in turn helps in reducing the chances of heart attack or stroke. It also contains certain plant lignans that get converted into animal lignans in the body. These lignans are also known for preventing heart disease. Bajra is also known for controlling your cholesterol levels.Bajra flour has high amounts of magnesium in it, due to which it helps in controlling the glucose receptors in the body. In the populations that have bajra or magnesium-rich foods in their diet, the occurrence of diabetes is reduced by at least 30 per cent**(Patni and Agrawal.,2017)**

The present study discussed in this paperfocuses on replacement of wheat flour by differentlevels of millet flours in muffins and thereafter, storage studies were carried out for the developed product.

2. MATERIALS AND METHODS

2.1.Purchase of raw materials and treatment combination

The ingredients like millet grains, whole milk, butter, baking soda were procured from the local market of Prayagraj. Maltodextrine was purchased from Bioven ingredients, Noida,Stevia was procured from Herboveda India, Noida and Lecithin powder was procured from urban platter, Noida.

The trails were conducted at Warner College of Dairy Technology, Prayagraj to study the effect of different levels of millets flour on nutritive attributes and shelf life of muffins. The different levels of three formulation were prepared by mixing pearl millet flour, finger millet flour and little millet flour, in which the percentage of pearl millet was constant.The millet % of S1 sample was 10%, 20%, 10% for S2 sample 10%, 15%, 15% and 10%, 10%, 20%was taken for sample S3.

2.2.Preparation of muffin samples

In this study, the preparation of multimilletflour based muffins were prepared from malted millet flour which was sieved through 250 µm mesh to get fine flour and then it was stored at refrigerated temperature for further preparation of muffins. Now, for the preparation of muffins40gms of millet flour with 0.9 gm of stevia, 14.1 maltodextrin, 4gms of baking powderand 1g lecithin powder is mixed altogether with 40 ml of whole milk poured in it to form a batter. In this, 40 gms of multi millet flour, three different millets, i.e., pearl millet, finger millet and little millet was mixed at different percentage for three different samples i.e., 10%, 20%, 10% for S1 sample 10%, 15%, 15% and 10%, 10%, 20% was taken for S2 and S3 samples. After the batter is prepared, greasing of the molds are done with butter to pour the batter in it. The alumi are further kept in a preheated oven (100°C for 30 mins.) for baking at temperature 180°C for 10-15mins. After the muffins are prepared they are allowed to cool for further packaging and storage.

2.3.Sensory evaluation of muffins

The control sample and millet based samples of muffins were prepared with addition of different levels of pearl millet flour, finger millet flour and little millet flour were evaluated by twenty panelists for the sensory qualities of color, texture, taste, aroma and overall acceptability using 9-Point Hedonic Scale. The muffins were standardized based on organoleptic scoreshighly acceptable muffins were further analyzed for nutrient values and shelf life studies.

2.4.Proximate analysis of muffins

The Nutritive value of the ingredients wereanalyzed by standard AOAC methods. The control and formulated muffins samples moisture content was determined adopting AOAC 2010. Protein, ash, fat and crude fiber were determined using AOAC. Total carbohydrate content of the sample was determined as total carbohydrate by difference, which is by subtracting the measured protein, fat, ash and moisture from 100 g.

2.5.Shelf life analysis of muffins

Shelf life study was conducted at ambient temperature (25 ± 2°) for 90 days along with control i.e. raw wheat flour muffins. The optimized muffin sample was packed in LDPE box during the storage and the sample was examined at every 15 days interval i.e. (0, 15, 30, 45, 60, 75 and 90) for nutritive quality and microbial count.

2.6.Statistical analysis

Statistical analysis was done using MS EXCEL 2007 excel version. The data was presented as mean ± SD value and theses values were calculated in triplicates.The type of ANOVA used was one-way analysis of variance (ANOVA) which was obtained by the use of Web Agri Stat Package.

3. RESULTS AND DISCUSSION

Sensory evaluation was carried outfor optimization themultimillet flour muffins. Sensory evaluation is the most important parameter for further evaluation of the product. The graph mentioned below in Fig.1 depicts the sensory mean scores for S0, S1, S2 and S3 samples. Sample S1 containing 10% pearl millet, 20% finger millet and 10% little millet showed the highest scores for color, texture, aroma, taste, and overall acceptability.The mean scores for color, texture, aroma, taste and overall acceptability wasscored as 9.8, 8.2, 9.3, 8.1 and 9.6 respectively.**Kawaiet al.,(2016)**reported thatcakes have distinct flavor, texture, and aroma; factors such as ingredients, processing, and maturation stage all come into play. The quality of the cake is ultimately determined by its texture, flavor, and aroma, all of which influence whether or not customers will accept it. Among the textures of cakes are soft, chewy, wet, and watery. While certain scents are available in weak, medium, and strong concentrations and flavors come in three different varieties: hot, sweet, and salty.A slightly low acceptable taste was observed in samples S2 and S3 respectively. The scores for these sample S2 were 8.6, 7.1, 6.8, 7.9 and 7.7 for color, texture, taste, aroma and overall acceptability respectively. And for sample S3 also the overall acceptability was lower than sample S1. As sample S1 was more acceptable than the other two samples, it was further analyzed for chemical composition, shelf life study and microbial study.

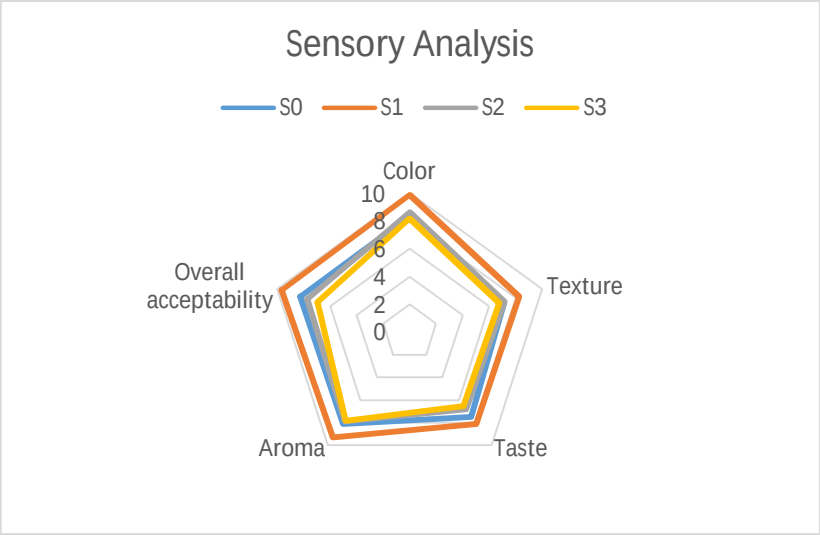

FIGURE 1: Graph depicting the sensory evaluation of muffins

3.1 PHYSIOCHEMICAL STUDY OF MUFFIN SAMPLES ON THE BASIS OF PROXIMATE ANALYSIS

The muffin samples were further subjected for the proximate analysis as the data is given in table 1 below for all the three samples i.e., S1, S2 and S3 constituting millet flours (40%) including the control sample S0 which is made up of wheat flour (40%). In the given data, S1 considering pearl millet, finger millet and little millet flours in 10%, 20% and 10% respectively gave an appropriate results for consumption. The moisture, fat, protein, carbohydrate and ash of sample S1 was significantly ($p<0.05$) higher with mean values 22.20, 18.21, 12.64, 45.23 and 1.94 respectively than S0 sample. Whereas, if we see for S2 muffin sample, the moisture content was 23.01, the fat content was 19.87, the protein content was 10.33, carbohydrate was found to be 46.3 and ash was 1.34. Similarly, when we observe the data for S3 sample, the protein and ash content are found to be 19.12 and 1.29 respectively which is lesser then the content found in sample S1. The carbohydrate content was found to be 46.91 in S3 sample which is higher than S1 sample ($p<0.05$).As reported by **(Mallasiy et al.,2023)**moisture required for bound cake to maintain its quality, and excessive moisture has a negative impact on cake storage stability.Also, the study indicated that the pearl millet increases the nutritive value of the muffins as it is a good source of fat and protein which helps to increase the nutritive value of bound cake.The composite bound cake may have had a higher protein level due to the usage of pearl millet flour, which enhanced the protein content of the bound cake **(Ijah et al., 2014)**.

Table 1: Table showing the proximate analysis of different muffin samples

PARAMETERS	S0	S1	S2	S3
MOISTURE (%)	**23.40**±0.02	**22.20**±0.04	**23.01**±0.06	**23.20**±0.01
FAT (%)	**20.59**±0.04	**18.21**±0.01	**19.87**±0.01	**19.12**±0.01
PROTEIN (%)	**10.23**±0.01	**12.64**±0.01	**10.33**±0.01	**10.43**±0.02
CARBOHYDRATE(%)	**46.22**±0.01	**45.23**±0.02	**46.3**±0.07	**46.91**±0.06
ASH (%)	**1.20**±0.01	**1.94**±0.01	**1.34**±0.01	**1.29**±0.06

3.2 STUDIES ON STORAGE PERIOD OF MULTIMILLET FLOUR MUFFINS ON THE BASIS OF PROXIMATE ANALYSIS AND MICROBIAL STUDY

Further the optimized sample S1 was kept for shelf life study for 90 days at ambient temperature. For the evaluation of the product, the optimized sample S1 was evaluated on the basis of proximate analysis and microbial study for 90 days. Muffins sample S1 prepared with millet flour (pearl millet (10%), finger millet (20%) and little millet (10%) exhibited significantly ($p<0.05$) higher fat, protein and ash as compared to wheat flour. The samples were kept for 90 days at ambient temperature for 15 days of interval, wherein, it was found that there was no major decrease for 60 days in protein, fat, carbohydrate and ash as mentioned below in the table 2. The protein content was found to be in between the range of 12.64% on D0 to 11.21% on D90. The moisture content of millet muffin was found to be in between 22.20 to 20.62 from D0 to D90 respectively. As reported by researchersmoisture content has an important role in affecting the storage stability of the product and less than 14% is consideredsuitable to preventenzyme activities and degradation.**(Rustagi et al.,2022).**During storage, the FFA value exhibited higher values during storage interval. The results were ranged between 0.77 to 1.31within 90 days. As the study was compared with **(Goswami et al.2015)**it stated thatduring the storage 100 g/100 g Barnyard millet flour muffins exhibited lesser Free fatty acid content than control muffins. Higher FFA was developed when the muffin samples were stored at refrigerated temperature. Similar studies were also found by **Shobana et al., (2013), Banusha and Vasantharuba (2013)**and **Kumar et al., (2016).** The tyrosin value of the sample was found to be in between the

range of 0.62 to 0.86 for 90 days.It was also studied that the millet muffin sample S1 stored at ambient temperature was acceptable up till 60 days as there was no microbial growth found in it. After 60 days, yeast and mold ($x10^1$ cfu/g) count was found which was not acceptable by the panelists.

Table 2: Table showing effect of shelf-life analysis on proximate composition of optimized sample

PARAMETERS	D0	D15	D30	D45	D60	D75	D90
MOISTURE (%)	22.20±0.04	22.11±0.00	22.13±0.01	22.02±0.01	21.87±0.01	21.64±0.01	20.62±0.01
FAT (%)	17.64±0.01	17.21±0.00	17.12±0.01	17.06±0.01	17.01±0.00	16.97±0.01	16.42±0.01
PROTEIN (%)	12.64±0.01	12.61±0.01	12.56±0.01	12.42±0.01	12.01±0.00	11.66±0.01	11.21±0.00
CARBOHYDRATE (%)	45.23±0.02	45.21±0.00	45.05±0.01	45.02±0.01	44.99±0.01	44.65±0.01	44.20±0.01
ASH (%)	1.94±0.01	1.91±0.00	1.87±0.01	1.62±0.01	1.426±0.01	1.14±0.01	0.99±0.01
FFA (%)	0.77±0.00	0.80±0.01	0.84±0.01	0.93±0.01	1.02±0.01	1.25±0.01	1.31±0.01
TYROSIN VALUE (%)	0.62±0.00	0.64±0.01	0.68±0.00	0.73±0.01	0.76±0.00	0.84±0.00	0.86±0.01

4. CONCLUSION

In conclusion this study confirmed that incorporation of different varieties of millet to the muffins formulation has improved the muffins quality attribute nutritionally protein, minerals, fat and ash. The organoleptic parameters like color, texture, taste, aroma and overall acceptability was also improved. The study confirmed that the blending of pearl millet, finger millet and little millet at 10%, 20% and 10% gave the best results. It is therefore concluded that S1 sample was highly acceptable and also gave the best results during storage period for 90 days. Based on the outcomes of the studies, it was that there was no physical changes and no much alteration was found in proximate analysis up to 60days of storage at ambient temperature.

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