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Studies on proximate analysis of biscuits using multigrain flours during ambient condition

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Abstract
Experiments were conducted to development, quality evaluation and storage stability of multigrain flour biscuits made flours wheat flour, maize flour, barley flour, pearl millet flour and gram flour. The biscuits were formulated by taking different proportion of multigrain flours in the ratio of (C) 100:0:0:0:0, (S_1) 90:2.5:2.5:2.5:2.5, (S_2) 80:5.0:5.0:5.0:5.0 and (S_3) 70:7.5:7.5:7.5:7.5, respectively. Wheat flour of the ratio of 100:0:0:0:0 was considered as control. Biscuits were packaged in Low density polyethylene after preparation. All the samples were stored at room temperature for 30 and 60 days for quality evaluation. After preparation of biscuit various physico-chemical properties were determined, i.e. pH, protein content, fat content, moisture content and ash content.

Keywords: Multigrain flour, Biscuits and Low density polyethylene

1. Introduction
The bakery industry in India is the biggest in food industry. It witnesses tremendous growth with the changing demographics and an improvement in the quality of life of urban people and rural people. Bakery is a traditional activity and occupies an important place in food processing industry. Despite the advent of fully automatic and semi-automatic bread as well as biscuit making Plants, a sizeable number of people still prefer fresh bread and other products from bakery. The bakery industry in India can be categorized into the three broad segments of bread, biscuits and cake. Only 40% of the 3 million tones bakery products industry in India is in the organized sector, while the balance comprises of unorganized, small-scale local manufacturers. With changing consumer tastes and with the entry of multinationals post liberalization, the average Indian is expanding his palate from just bread, cake and biscuits to more sophisticated pizzas and burgers.
Wheat flour approximately consists of 72% carbohydrates, 8-13 % protein, 12-13% moisture, 2.5% fat, 1.0% soluble protein and 0.5% minerals salt (Oberoi *et al.*, 2007) [11]. Wheat flour is a powder made from the grinding of wheat used for human consumption. More wheat flour is produced than any other flour. Wheat varieties are called “clean” or “white” or “brown” if they have high gluten content is low. Hard flour or bread flour is high gluten, with 12% to 14% gluten content and has elastic toughness that holds its shape well once baked. Soft flour is comparatively low in gluten and so result in a finer or crumbly texture. Soft flour is usually divided into cake flour, which is the lowest in gluten, and pastry flour, which has slightly more gluten than cake flour.
Millet contains an average of 10 - 12% protein. While its protein is superior to that of wheat or corn in terms of content of essential amino acids, it nonetheless contain less than half the amount of the essential amino acid lysine that is found in high quality protein sources such as meat. Millet lacks gluten, the wheat protein that makes dough prepared from wheat flour elastic; hence millet flour is not suitable for leavened breads. Millet flour is used in making flat cakes and breads. The whole grain is used in soups, stews or as a cooked cereal. It is also popped; roasted or sprouted**.** Millets are unique among the cereals because of their richness in calcium, dietary fiber, polyphones and protein (Devi *et al.,* 2011). The amino acids content in different types of millets.
The demand for processed foods is ever increasing due to the technological, industrial and economic advances of the developing societies of the world including India. The bakery industry has been steadily growing in the country, being the largest among the processed food industries. The two major bakery industries namely bread and biscuits account for almost 82 % of the total bakery products. The annual production of bakery products is estimated to be more than 3.0 million tons (www.biscuitfederation.org). India is recognized to be the second largest producer of biscuits next only to the United States of America with annual production of which was 7.40 lakh metric tons in 1997-98 which has escalated to 17.14 lakh metric tones in 2005-2009 (Agrawal, 1990).

2. Materials and Methods
The experiments were conducted to develop multigrain biscuits and its physico-chemical and sensory quality during storage. Multigrain flour comprising wheat flour, maize flour, barley flour, pearl millet flour and gram flours were used for the present study. The biscuits were formulated using various proportions of flours and other ingredients. All the experiments were conducted in food analysis laboratory and bakery laboratory in the Department of Agricultural Engineering and Food Technology. Multigrain biscuits were packaged in LDPE at room temperature and analyse the physico-chemical characteristics like moisture content, ash content, fat content, protein content and pH. The sensory characteristics were done on the basis of color, flavor, taste, texture and overall acceptability as fresh and during storage for 60 days. The study aimed to explore the potentials of multigrain flour for the development of biscuits.

Development of multigrain flour biscuits
Multigrain biscuits were prepared by incorporating different levels of flours viz., wheat flour, maize flour, millet flour,

barley flour, gram flour blends in ratio of 100:0:0:0:0, 90: 2.5:2.5:2.5:2.5, 80:5:5:5:5, 70:7.5:7.5:7.5:7.5 respectively. The recipe used for preparation of multigrain biscuits is 100 g flour, 45 g sugar, 45 g ghee, milk powder 10 g, 1.5 g baking powder, water and flavor. All the materials were mixed by hand until firm dough was formed. The dough was rolled out in a baking tray and cut into round in shape with a mould. The biscuits were placed in greased aluminum trays and baked in convection oven at 150 ºC for 25 - 30 minutes. After baking the biscuits were taken out of oven and cooled at room temperature. At last, the cooled biscuits were packed into LDPE bags and stored under ambient condition for further studies.

Estimation of physico-chemical characteristics of biscuits

Moisture content A known quantity of sample was weighed into previously weighed moisture cups and dried in a hot air oven at 98 to 105 ºC to a constant weight (Anon., 1883) [3].

Ash Content Muffle furnace (TANCO model) was used to determine the ash content of the samples.

Fat Estimation Fat was estimated using procedure reported by (David A. Katz 2004) [8]

Protein estimation Protein was analytically estimated by determining the amount of total nitrogen in the sample (AOAC, 2000) [5]

Statistical Analysis the results of the study analyzed statistically to know its significance. Hence, suitable statistical methods were used for data obtained in the present study. Mean, standard deviations were used to interpret mean sensory scores of biscuits and to test the difference between the organoleptic scores of biscuits. Physical characteristics of biscuits were analyzed using completely randomized block design.

Analysis of Variance

Data was analyzed with the help of STATPAC (OPSTAT) software and the analysis of samples was carried out at 5% level of significance.

3. Result and Discussions

The studies were conducted on development and quality evaluation of multigrain biscuits by incorporating various proportions of flours. eg, wheat flour, maize flour, millet flour, barley flour and gram flour. The quality of the fresh multigrain biscuits were evaluated on the basis of physico-chemical characteristics like moisture content, ash content, fat content, protein content and pH.

Effect on Moisture content

The moisture content of 7.5% mixed flour (S_3) based biscuits showed highest value of (4.95%) in comparison control biscuits which had lowest value (2.96%) after the 60 days of ambient storage the moisture content of biscuits with different flour composition are shown in Table 1. The moisture content of mixed flour based biscuits increased with increase the level of mixed flour. Similar effect was observed by Alam *et al.*, (2003) [2] where moisture content of all biscuits was higher than that of control biscuits. Moisture content was found less than the biscuits samples made from mixed flours.

The storage study shows significantly ($p<0.05$) increased moisture content of biscuit samples during ambient storage. Labuza and Schmidl (1985) [9] suggested moisture absorption of the water vapor present in the air present inside the package. Another possibility of the moisture increase may be due to air intake from the package seal.

Effect on Fat content

The variation in fat content (%) of biscuits during 60 days of ambient storage present in Table 2. The fat of biscuits was observed for control biscuits (24.19%), W_{90} (25.44%), W_{80} (27.44%), and W_{70} (30.25%). The result revealed that the fat content of biscuits decreased with increase in the incorporation of barley flour, millet flour, gram flour, maize flour and fat content of control biscuits was decreased also with increasing in storage period up to 60 days of ambient storage. Fat decreased in control biscuits from (24.19-23.21) at 60 days ambient storage and respectively while in W_{70} (30.25-29.10) during storage of 60 days of ambient storage. The higher fat in multigrain flour biscuits might be due to higher fat content in green gram flour as compared to wheat flour, potato flour and rice flour similar trends by Anu *et al.,* (2007) [4].

The analysis of variance (ANOVA) for fat content is evident that fat content of biscuits increased with increase in the incorporation of different flours with wheat flour. The effect of incorporation of different mixed flours and storage on fat content of biscuits were found to be significant at $p<0.05$ level of significance. The highest fat was recorded for W_{70} biscuits and lowest in control biscuits as compared to other samples after storage of 60 days of ambient storage.

Effect on pH content

The data for variation in pH (%) by incorporation of different flours and storage of biscuits are presented in Table 3. The pH range for fresh biscuits was observed 6.43-6.83 among all the biscuits sample. Highest pH was evaluated for W_{70} biscuits (6.83) followed by W_{80} (6.78), W_{90} (6.59) while lowest for control biscuits (6.43) for 60 days of ambient storage. By increase the incorporation of barley flour, gram flour, millet flour, and maize flour with wheat flour the pH of biscuits increased. The pH value decreased for W_{100} (6.43-6.23), W_{90} (6.59-6.42), W_{80} (6.78-6.61) and W_{70} (6.83-6.71) at 0 day to 60 days of ambient storage respectively.

Effect on Protein content

The data for variation in protein content [%] of biscuit packaged in LDPE, during storage under ambient condition are present in table 4. By incorporation of mixed protein content flours for control biscuits (6.67%), W_{90} (6.83%), W_{80} (6.94%) and W_{70} (7.08%). The protein content of biscuit increased with the increased levels of different flours (Table 4.5). The biscuit made from 7.5% multigrain flour had highest value (7.08%) and lowest in control biscuit (6.67%). Similar trends were found by Agu *et al.,* (2007) [1] also reported higher protein content in pearl millet and green gram as compared to refined wheat flour. The higher protein content in pearl millet based biscuit as compared to control might be due to higher level to protein in pearl millet and green gram.

The effect of storage and packaging materials along with incorporation of mixed flours on protein content of biscuits were found to be significant at $p<0.05$ level of significance. The effect of 60 days of ambient on protein content for biscuits were observed non-significant at $p<0.05$ level of significance.

Effect on Ash content

The data on variation in ash content (%) of wheat flour and multigrain flour and biscuits packaged in LDPE stored at ambient condition up to 60 days present in Table 5. By the incorporation of multigrain flour and packaging material the ash content for biscuits ranged 1.17 to 1.32 % varied ambient storage. Highest ash was observed for freshly prepared W_{70} biscuits (1.32%) followed by W_{80} (1.29%) and W_{90} (1.24%), while lowest for control biscuits (1.17%). Ash content decreased gradually in the range for control biscuits (1.17-1.10%), W_{90} (1.24-1.21%), W_{80} (1.29-1.23%), and W_{70} (1.32-1.28%) at 60 days ambient storage.

The individual wheat flour biscuits (control) sample showed very low value of ash content (1.17%), where as 7.5% mixed flour based biscuits show highest value (1.32%). Also 5% and 2.5% mixed flour based biscuits obtained higher value of ash content than control biscuits. So result are clear that ash content of mixed flour based biscuits significance increased with increase in the level of mixed flour.

Kabirullaha *et al.,* (1995) [7] analyzed cracker type (7 brands) biscuits and has reported the ash content in biscuits increased with increase the level of different flours. The effect of storage period and packaging materials along with incorporation of flours on ash content were found to be significant at $p<0.05$ level of significance. Highest ash content was observed for W_{70} biscuits while lowest for control biscuits at 60 days of ambient storage.

Table 1: Moisture content of Biscuit samples during ambient storage

Sample code	Storage period samples		
	0 day	30 days	60 days
C	2.66±0.04	2.77±0.04	2.96±0.04
S_1	3.19±0.06	3.38±0.07	3.60±0.08
S_2	3.81±0.65	4.04±0.09	4.29±0.07
S_3	4.51±0.08	4.74±0.08	4.95±0.06

CD at (0.05) =0.082

Table 2: Fat content of multigrain biscuit samples during 60 days of ambient storage

Sample code	Storage period samples		
	0 day	30 days	60 days
C	24.19 ±0.06	23.83 ±0.04	23.21 ±0.06
S_1	25.44 ±0.05	24.87 ±0.01	24.20 ±0.04
S_2	27.44 ±0.02	26.80 ±0.02	26.20 ±0.05
S_3	30.25 ±0.04	29.71 ±0.04	29.10 ±0.03

CD at (0.05) = 0.145

Table 3: pH of multigrain biscuit samples during 60 days of ambient storage

Sample code	Storage period samples		
	0 day	30 days	60 days
C	6.43 ±0.03	6.31 ±0.02	6.23 ±0.02
S_1	6.59 ±0.01	6.48 ±0.02	6.42 ±0.04
S_2	6.78 ±0.02	6.68 ±0.02	6.61 ±0.02
S_3	6.83 ±0.02	6.75 ±0.02	6.71 ±0.02

CD at (0.05) = 0.034

Table 4: Protein content of multigrain biscuit samples during 60 days of ambient storage

Sample code	Storage period samples		
	0 day	30 days	60 days
C	6.67 ±0.05	6.63 ±0.05	6.42 ±0.06
S_1	6.83 ±0.04	6.76 ±0.04	6.72 ±0.03
S_2	6.94 ±0.03	6.87 ±0.02	6.78 ±0.03
S_3	7.08 ±0.03	7.04 ±0.03	6.99 ±0.02

CD at (0.05) = 0.089

Table 5: Ash content of multigrain biscuit samples during 60 days of ambient storage

Sample code	Storage period samples		
	0 day	30 days	60 days
C	1.17 ±0.04	1.14 ±0.03	1.10 ±0.03
S_1	1.24 ±0.03	1.22 ±0.02	1.21 ±0.02
S_2	1.29 ±0.02	1.26 ±0.02	1.23 ±0.03
S_3	1.32 ±0.03	1.30 ±0.03	1.28 ±0.03

CD at (0.05) = 0.019

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