Research Article

Effect of Storage on the Quality of Wheat and Maize Based Cookies

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Abstract | The aim of this study was to prepare cookies from common wheat and maize composite flour. The formulations of the study were F_0 (100% wheat flour), F_1 (90% wheat flour + 10% maize flour), F_2 (80% wheat flour + 20% maize flour), F_3 (70% wheat flour + 30% maize flour), F_4 (60% wheat flour + 40% maize flour), F_5 (50% wheat flour + 50% maize flour), and F_6 (100% maize flour). Physicochemical analysis of the cookies showed the different trend from F_0 to F_6. Mean score for moisture content increased and the ranged between F_0-F_6 (3.24-3.29%), other physicochemical parameters showed decreasing trend like ash (0.80-0.73%), fat 24.23-23.94%), protein (8.20-7.68%), fiber (6.47-6.38%) while NFE increased slowly (57.86-58.60%). The color of the cookies ranged from F_0-F_6 (6.88-6.93), taste ranged F_0-F_6 (6.82-6.04) and texture ranged F_0-F_6 (6.91-6.15). Maximum overall acceptability was recorded in F_2 (7.32) proceeded by F_0 (6.99) whereas minimum mean score was recorded in F_6 (6.37) proceeded by F_5 (6.47).

Received | March 27, 2018; **Accepted** | August 11, 2018; **Published** | August 26, 2018

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Citation | Akbar, K. and M.Ayub. 2018. Effect of storage on the quality of wheat and maize based cookies. *Sarhad Journal of Agriculture,* 34(3): 606-615.

DOI | http://dx.doi.org/10.17582/journal.sja/2018/34.3.606.615

Keywords | Wheat, Maize, Cookies, Physico-chemical properties, Storage study

Introduction

Wheat (*Triticum aestivum* L.) is considered the topmost consumed cereal (Vrcek and Vrcek, 2012) in many countries (Shar et al., 2002). According to (Goesaert et al., 2005) its frequent usage in bakery products worldwide gave it an eager over others. Wheat used for consumption of humans is thoroughly milled into starchy endosperm (white flour), barn and germ. Preparation of bakery products such as bread, cake, and cookies extensively consume white flour irrespective of its low level of minerals (De Brier et al., 2015). Major, minor and trace elements importance can never be neglected in the human body and high intake of cereals in the diet is a major source of those elements (Vrcek and Vrcek, 2012). Moreover, its well knew that dietary intake of essential elements through cereals is insufficient and their elemental bioavailability is low (Koplik et al., 2006). Parts of grains having the greater concentration of other elements are inversely affected by milling into white flour (Xue et al., 2014).

Wheat is used in the preparation of bakery products like cake, cookies, and bread. The environmental condition in the genotype of wheat can greatly influence the gluten content which forms a visco elastic network (Hasniza et al., 2014; Gupta et al., 1992). Due to variation in protein, wheat is used in the production of varieties of the product like for bread making hard wheat variety is used which has a strong gluten network and for the production cookies, and cakes, soft wheat flour is used having low protein content (Dobraszczyk and Morgenstern, 2003).

Maize (*Zea mays* L.) is the important crop through-

out the world in term of food and feed. After wheat and rice maize is the important cereal crop used in Pakistan. It is used in the manufacturing of bakery products like cake, bread, and cookies. It is used as a feed for poultry and livestock and also an important food grain for human consumption (Bukhsh et al., 2011). Apart from human consumption, it is also used in the production of non-food items like soaps, paints, and varnishes. Maize is a biennial crop grown in autumn and spring. Due to change in climatic condition, the yield of the maize crop is less as compare to other countries (Bukhsh et al., 2010).

Composite flour is a mixture of different flours. Composite flour is best suited for cookies because of its consumption worldwide and by peoples of all ages (Arshad et al., 2007; Chavan and Kadam, 1993). Characterized by long shelf life and ready to eat snack (Gupta et al., 2011) cookies possess the huge potential to be an improved product providing special dietary needs. Another aspect for preferring cookies with better nutritional value is the preservation of products sensory attributes by taking account that the consumers' satisfaction remains the key point which determines a successful appliance of a newly formulated product (Skrbic and Cvejanov, 2011). Many research works have been done to improve the nutritive value of cookies (Sarabhai et al., 2014). Soluble fibers of barley can enrich chocolate chip cookies (Frost et al., 2011).

Cookies are known in the United Kingdom as a type of biscuits while referred to as "cookies" in the USA and regarded as confectionaries food with low moisture content (Albert et al., 1999). Through the action of heating in oven cookies obtained from single or composite dough are converted into digestible and much more appetizing products (Singh et al., 2000).

The main aim of the study is to prepare modified cookies from common wheat and maize composite flour. To select the best possible formulation of wheat, maize and wheat-maize blended cookies and to evaluate physicochemical and sensory attributes of prepared cookies during storage.

Materials and Methods

Selected wheat variety (Atta Habib) and maize (Azam) was purchased from Plant Breeding and Genetics Department, The University of Agriculture Peshawar. The grains were brought to food and nutrition laboratory of Nuclear Institute for Food and Agriculture (NIFA) Tarnab Peshawar. The grains were milled by using laboratory scale flour mill. The flour was packed in air tight plastic jars for cookies preparation.

Table 1: Shows different formulation of wheat, maize and wheat maize blended flour for cookies preparation. Formulation Combinations.

S.NO	Formulations	Wheat Flour %	Maize Flour%
1	F_0	100 %	0 %
2	F_1	90%	10%
3	F_2	80%	20%
4	F_3	70%	30%
5	F_4	60%	40%
6	F_5	50%	50%
7	F_6	0%	100%

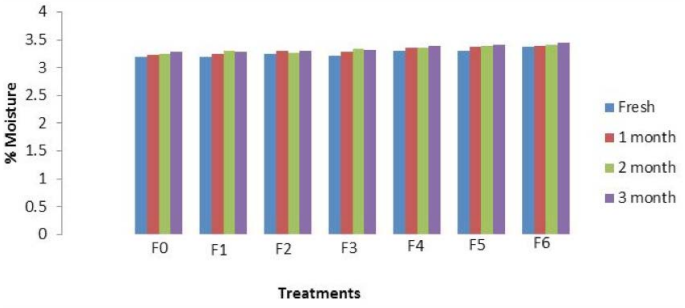

Figure 1: *Effect of moisture during storage on wheat and maize based cookies.*

Cookies Preparation

For cookies preparation the method used by Shazia et al., 2012 was followed with some modification (Table 3).

Proximate analysis of cookies

The method described by AACC (2012) was used for the determination of moisture, ash, fiber, crude fat and crude protein.

Nitrogen Free Extract (NFE)

The nitrogen free extract content was determined according to the procedure described by Iqtidar and Saleemullah (2004).

Sensory attributes

The samples of cookies were evaluated by senses for color, taste, texture and overall acceptability by the panels of 15 judges. The evaluation was carried out by using 9 points hedonic scale of Larmond (1977).

Scale: (9 like extremely) (8 like very much) (7 like moderately) (6 like slightly) (5 neither like nor dislike) (4 dislike slightly) (3 dislike very much) (2 dislike moderately) (1 dislike extremely).

Table 2: *Different ratios of wheat and maize flour for cookies development.*

S. No	Ingredients	Control (100% Wheat flour)	10% Maize flour	20% Maize flour	30% Maize flour	40% Maize flour	50% Maize flour	100% Maize flour
1	Wheat flour (g)	200	180	160	140	120	100	0
2	Maize flour (g)	0	20	40	60	80	100	200
3	Shortening (g)	100	100	100	100	100	100	100
4	Sugar (g)	100	100	100	100	100	100	100
5	Egg (number)	1	1	1	1	1	1	1
6	Baking powder (g)	3	3	3	3	3	3	3

Statistical analysis

The Data analyzed by using CRD two factor and the means were separated by LSD test using Statistix 8.1 software as described (Steel and Torrie, 1997).

Table 3: *Formula used for cookies making.*

Ingredient	Quantity
Flour	150 g
Sugar	75 g
Shortening	75 g
Baking powder	2g
Egg (number)	1

Table 4: *Moisture content of cookies.*

Formulations	Storage intervals (Months)				Mean	% Inc
	0	1	2	3		
F_0	3.20	3.23	3.25	3.28	3.24 E	2.44
F_1	3.19	3.23	3.25	3.29	3.24 DE	3.04
F_2	3.21	3.24	3.27	3.30	3.26 CD	2.73
F_3	3.22	3.25	3.28	3.32	3.27 C	3.01
F_4	3.23	3.24	3.27	3.30	3.26 B	2.12
F_5	3.23	3.25	3.28	3.31	3.27 B	2.42
F_6	3.25	3.27	3.31	3.34	3.29 A	2.69
Mean	3.22D	3.24C	3.27B	3.31A		

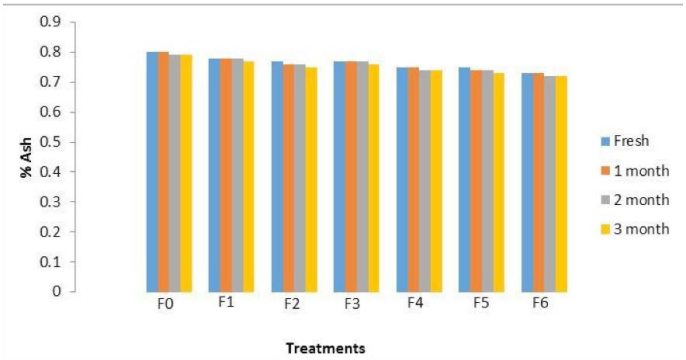

Figure 2: *Effect of ash during storage on wheat and maize based cookies.*

Results and Discussion

Cookies analysis

Moisture: The percent moisture content of cookies was given in Table 4. The percent moisture content of freshly prepared cookies (F_0 – F_6 stored for three months) were 3.2, 3.19, 3.21, 3.22, 3.23, 3.23 and 3.25% respectively. The percent moisture content after one month were 3.23, 3.23, 3.24, 3.25, 3.24, 3.25 and 3.27%, while after second month the percent moisture content were 3.25, 3.25, 3.27, 3.28, 3.27, 3.28 and 3.31%, after the third month the percent moisture content of cookies were 3.28, 3.29, 3.30, 3.32, 3.30, 3.31 and 3.34%. The percent moisture content of cookies significantly ($p<0.05$) increased from 3.22 to 3.31% during three months evaluation. Maximum mean percent moisture content was observed in F_6 (3.29%) proceeded by F_3 and F_5 (3.27%) whereas minimum mean percent moisture content was observed in F_0 and F_1 (3.24%) proceeded by F_2 and F_4 (2.26%). During the storage highest increased was recorded in F_1 (3.04%) proceeded by F_3 (3.01%) whereas the least increased was recorded in F_4 (2.12%) proceeded by F_5 (2.42%).

The statistical application indicated that treatment effect and storage intervals had a significant effect ($p<0.05$) on percent moisture of the cookies. The analyzed data regarding moisture of the cookies was similar to the data of Waheed et al. (2010) that carried out the research work on the effect of cottonseed and palm oil blends on the quality of cookies. Uysal et al. (2007) who analyzed notable effect on moisture by enrichment with fiber in cookies.

Ash: The percent ash content of cookies was presented in Table 5. The percent ash content of freshly prepared cookies (F_0 – F_6 stored for three months) were 0.80, 0.78, 0.77, 0.77, 0.75, 0.75 and 0.73% respectively. The percent ash content of cookies after one month were 0.80, 0.78, 0.76, 0.77, 0.75, 0.74 and 0.73%, while after second month the percent ash con-

tent were 0.79, 0.78, 0.76, 0.77, 0.74, 0.74 and 0.72%, after third month the percent ash content of cookies were 0.79, 0.77, 0.75, 0.76, 0.74, 0.73 and 0.72%. The percent ash content of cookies significantly ($p<0.05$) decreased from 0.76 to 0.75% during three months evaluation. The highest ash content was observed in F_0 (0.80%) proceeded by F_1 (0.78%) whereas minimum mean percent ash content was recorded in F_6 (0.72%) proceeded by F_5 (0.74%). During the period of storage highest decreased was recorded in F_5 (2.67%) proceeded by F_2 (2.60%) whereas the minimum decreased was recorded in F_1 (1.28%) proceeded by F_3 (1.30%).

Table 5: *Ash content of cookies.*

Formulations	Storage intervals (Months)				Mean	% Dec
	0	1	2	3		
F_0	0.80	0.80	0.79	0.79	0.80 A	1.25
F_1	0.78	0.78	0.78	0.77	0.78 B	1.28
F_2	0.77	0.76	0.76	0.75	0.76 C	2.60
F_3	0.77	0.77	0.77	0.76	0.77 D	1.30
F_4	0.75	0.75	0.74	0.74	0.75 E	1.33
F_5	0.75	0.74	0.74	0.73	0.74 F	2.67
F_6	0.73	0.73	0.72	0.72	0.73 G	1.37
Mean	0.76A	0.76AB	0.76AB	0.75B		

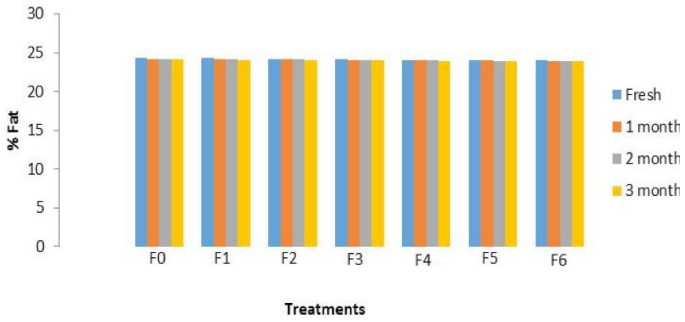

Figure 3: *Effect of fat during storage on wheat and maize based cookies.*

The statistical application indicated that treatment effect and storage intervals had a significant effect ($p<0.05$) on percent ash content of the cookies. The analyzed data regarding ash of the cookies was similar to the data of Hussein et al. (2011) who got the results that revealed a similar increased trend in ash content due to fiber addition. Waheed et al. (2010) carried out the research work on the effect of cottonseed and palm oil blends on the quality of cookies and analyzed the same results.

Crude fat: The crude fat of cookies was given in Table 6. The crude fat of freshly prepared cookies (F_0 – F_6 stored for three months) were 24.30, 24.28, 24.23, 24.15, 24.10, 24.05 and 24.01% respectively. The crude fat content of cookies after one month were 24.25, 24.21, 24.20, 24.11, 24.05, 24.06 and 23.96%, while after second month the crude fat content were 24.20, 24.15, 24.16, 24.07, 24.00, 23.96 and 23.91%, after the third month the crude fat content of cookies were 24.17, 24.10, 24.11, 24.02, 23.95, 23.91 and 23.87%. The crude fat content of cookies significantly ($p<0.05$) decreased from 24.16 to 24.02% during three months evaluation. The maximum mean crude fat content was observed in sample F_0 (24.23%) proceeded by F_1 (24.19%) whereas minimum mean crude fat content was recorded in F_6 (23.94%) proceeded by F_5 (23.98%). During the storage maximum decreased was recorded in F_1 (0.74%) proceeded by F_4 (0.62%) whereas least decreased was recorded in F_2 (0.50%) proceeded by F_0 (0.53%).

Table 6: *Crude fat content of cookies.*

Formulations	Storage intervals (Months)				Mean	% Dec
	0	1	2	3		
F_0	24.30	24.25	24.20	24.17	24.23 A	0.53
F_1	24.28	24.21	24.15	24.10	24.19 B	0.74
F_2	24.23	24.20	24.16	24.11	24.18 B	0.50
F_3	24.15	24.11	24.07	24.02	24.09 C	0.54
F_4	24.10	24.05	24.00	23.95	24.03 D	0.62
F_5	24.05	24.00	23.96	23.91	23.98 E	0.58
F_6	24.01	23.96	23.91	23.87	23.94 F	0.58
Mean	24.16A	24.11B	24.06C	24.02D		

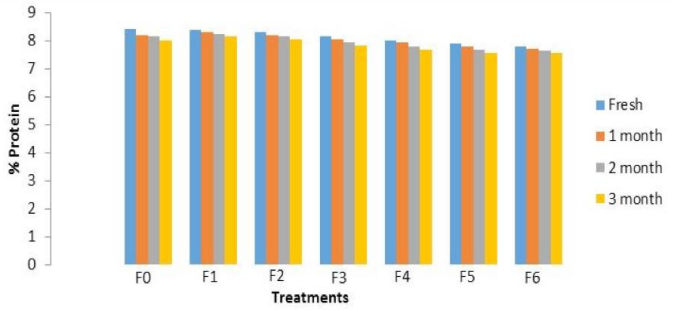

Figure 4: *Effect of protein during storage on wheat and maize based cookies.*

The statistical application indicated that treatment effect and storage intervals had effect significantly ($p<0.05$) on crude fat content of the cookies. The analyzed data regarding fat of the cookies was similar to the data of Pasha et al. (2002) which analyzed that in bakery products fat contents may be decreased when moisture content increased. Waheed et al. (2010) carried out the research work on the effect of cottonseed

and palm oil blends on the quality of cookies and analyzed the same results.

Table 7: *Crude protein content of cookies.*

Formulations	Storage intervals (Months)				Mean	% Dec
	0	1	2	3		
F_0	8.42	8.21	8.15	8.03	8.20 A	4.63
F_1	8.38	8.30	8.23	8.15	8.27 B	2.74
F_2	8.30	8.21	8.16	8.07	8.19 B	2.77
F_3	8.15	8.06	7.95	7.84	8.00 C	3.80
F_4	8.00	7.93	7.81	7.70	7.86 D	3.87
F_5	7.92	7.79	7.70	7.59	7.75 E	4.17
F_6	7.81	7.72	7.64	7.56	7.68 F	3.20
Mean	8.15A	8.03B	7.95C	7.85D		

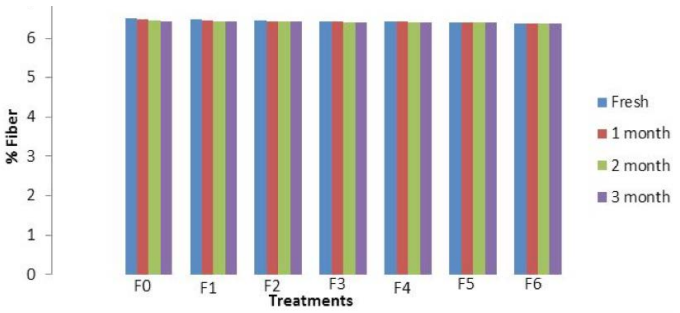

Figure 5: *Effect of fiber during storage on wheat and maize based cookies.*

Crude protein: The crude protein of cookies was given in Table 7. The crude protein of freshly prepared cookies (F_0 – F_6 stored for three months) were 8.42, 8.38, 8.30, 8.15, 8.00, 7.92 and 7.81% respectively. The crude protein content of cookies after one month were 8.21, 8.30, 8.21, 8.06, 7.93, 7.79 and 7.72%, while after second month the crude protein content were 8.15, 8.23, 8.16, 7.95, 7.81, 7.70 and 7.64%, after the third month the crude protein content of cookies were 8.03, 8.13, 8.07, 7.84, 7.70, 7.59 and 7.56%. The crude protein content of cookies significantly ($p<0.05$) decreased from 8.15% to 7.85% during the three months evaluation. The maximum mean crude protein content was observed in sample F_1 (8.27%) proceeded by F_0 (8.20%) whereas the minimum mean crude protein content was observed in sample F_6 (7.68%) proceeded by F_5 (7.75%). During the storage maximum decreased was recorded in F_0 (4.63%) proceeded by F_5 (4.17%) whereas the least decreased was observed in F_1 (2.74%) proceeded by F_2 (2.77%). The statistical application indicated that treatment effect and storage intervals had a significant effect ($p<0.05$) on crude protein of the cookies. The analyzed data regarding protein of the cookies was similar to the data of Waheed et al. (2010) that carried out the research work on the effect of cottonseed and palm oil blends on the quality of cookies. Another factor for reducing trend in protein may be due to the elevated moisture content of the cookies. Similar research carried out by Bilgicli et al. (2007), they recorded that the protein were reduced.

Table 8: *Fiber content of cookies.*

Formulations	Storage intervals (Months)				Mean	% Dec
	0	1	2	3		
F_0	6.50	6.47	6.45	6.44	6.47 A	0.92
F_1	6.47	6.45	6.44	6.42	6.45 B	0.77
F_2	6.46	6.44	6.43	6.42	6.44 B	0.62
F_3	6.44	6.43	6.41	6.41	6.42 C	0.47
F_4	6.43	6.42	6.41	6.41	6.42 D	0.31
F_5	6.41	6.40	6.40	6.39	6.40 E	0.31
F_6	6.38	6.38	6.37	6.37	6.38 F	0.16
Mean	6.44A	6.43AB	6.42B	6.41C		

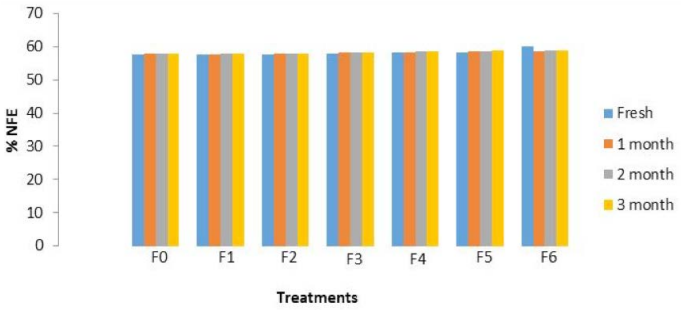

Figure 6: *Effect of NFE during storage on wheat and maize based cookies.*

Fiber: The fiber content of cookies was presented in Table 8. The fiber content of freshly prepared cookies (F_0 – F_6 stored for three months) were 6.50, 6.47, 6.46, 6.44, 6.43, 6.41 and 6.38% respectively. The fiber content of cookies after one month were 6.47, 6.45, 6.44, 6.43, 6.42, 6.40 and 6.38%, while after the second month the fiber content were 6.45, 6.44, 6.43, 6.41, 6.41, 6.40 and 6.37%, after the third month the fiber content of cookies were 6.44, 6.42, 6.42, 6.41, 6.41, 6.39 and 6.37%. The fiber content of cookies significantly ($p<0.05$) decreased from 6.44% to 6.41% during three months evaluation. The highest fiber content was recorded in F_0 (6.47%) proceeded by F_1 (6.45%) whereas least fiber content was recorded in F_6 (6.38%) proceeded by F_5 (6.40%). During the storage maximum decreased was recorded in F_0 (0.92%) proceeded by F_1 (0.77%) whereas the minimum de-

creased was recorded in F_6 (0.16%) proceeded by F_4 and F_5 (0.31%).

The statistical application indicated that treatment effect and storage intervals had effect significantly ($p<0.05$) on the fiber content of the cookies. The analyzed data regarding fiber of the cookies was similar to the data of Hussein et al. (2011) they added germinate fenugreek seed flour. Waheed et al. (2010) carried out the research work on the effect of cottonseed and palm oil blends on the quality of cookies and analyzed the same results.

Table 9: *NFE content of cookies.*

Formulations	Storage intervals (Months)				Mean	% Inc
	0	1	2	3		
F_0	57.58	57.84	57.95	58.08	57.86 A	0.86
F_1	57.68	57.79	57.88	58.04	57.85 B	0.62
F_2	57.77	57.85	57.98	58.10	57.93 B	0.57
F_3	58.04	58.11	58.23	58.41	58.20 BC	0.63
F_4	58.16	58.25	58.43	58.54	58.35 C	0.65
F_5	58.31	58.44	58.69	58.69	58.50 C	0.65
F_6	58.43	58.54	58.66	58.75	58.60 C	0.54
Mean	58.00D	58.12C	58.24B	58.37A		

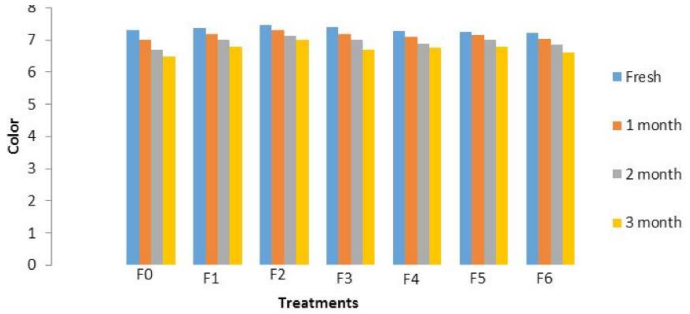

Figure 7: *Effect of color during storage on wheat and maize based cookies.*

NFE (Nitrogen Free Extract): The NFE content of cookies were presented in Table 9. The NFE content of freshly prepared cookies (F_0 – F_6 stored for three months) were 57.58, 57.68, 57.77, 58.04, 58.16, 58.31 and 58.43% respectively. The NFE content of cookies after one month were 57.84, 57.79, 57.85, 58.11, 58.25, 58.44 and 58.54 %, while after the second month the NFE content were 57.95, 57.88, 57.98, 58.23, 58.43, 58.69 and 58.66%, after the third month the NFE content of cookies were 58.08, 58.04, 58.10, 58.41, 58.54, 58.69 and 58.75%. The NFE content of cookies significantly ($p<0.05$) increased from 58.00% to 58.37% during the three months evaluation. The highest NFE content was recorded in F_6 (58.60%) proceeded by F_5 (58.50%) whereas the minimum NFE content was recorded in F_1 (57.85%) proceeded by F_0 (57.86%). During the storage period highest increased was recorded in F_0 (0.86%) proceeded by F_4 and F_5 (0.65%) whereas the minimum increased was recorded in F_6 (0.54%) proceeded by F2 (0.57%).

The statistical application indicated that treatment effect and storage intervals had a significant effect ($p<0.05$) on the NFE content of the cookies. The analyzed data regarding NFE of the cookies was similar to the data of Hussein et al. (2011) they added germinate fenugreek seed flour. Other factor for reduce trend in NFE may be due to elevated moisture content of the cookies. Similar research carried out by Bilgicli et al. (2007), they recorded that NFE were reduced.

Sensory evaluation: The fresh cookies samples prepared from wheat, maize and wheat-maize blended flour (stored for three months) were evaluated by means of sensory for color, taste, texture, and overall acceptability by panels of 15 trained judges.

Table 10: *Color of the cookies.*

Formulations	Storage intervals (Months)				Mean	% Dec
	0	1	2	3		
F_0	7.3	7	6.71	6.50	6.88D	1.96
F_1	7.37	7.2	7	6.80	7.09 B	7.73
F_2	7.45	7.3	7.12	7	7.22 A	6.04
F_3	7.39	7.2	7	6.70	7.07 B	9.34
F_4	7.28	7.1	6.9	6.75	7.01 BC	7.28
F_5	7.25	7.15	7.02	6.80	7.06 B	6.21
F_6	7.21	7.05	6.85	6.60	6.93 CD	8.46
Mean	7.32A	7.14B	6.94C	6.74D		

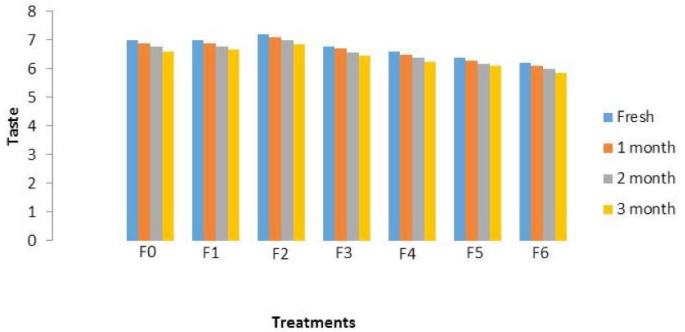

Figure 8: *Effect of taste during storage on wheat and maize based cookies.*

Color: The mean score of judges for color were presented in Table 10. The mean score of judges for the color of fresh prepared cookies (F_0 – F_6 stored for

three months) were 7.3, 7.37, 7.45, 7.39, 7.28, 7.25 and 7.21 respectively. The score after one month were 7, 7.2, 7.3, 7.2, 7.1, 7.15 and 7.05, while after second month the mean score were 6.71, 7, 7.12, 7, 6.9, 7.02 and 6.85 and after third month the score of cookies were 6.50, 6.80, 7, 6.70, 6.75, 6.80 and 6.60. The overall mean score of judges for the color of cookies significantly ($p<0.05$) decreased from 7.32 to 6.74 during three months evaluation. The maximum mean score was recorded in F_2 (7.22) proceeded by F_1 (7.09) whereas the minimum mean score was recorded in F_0 (6.88) proceeded by F_6 (6.93). During the storage maximum decreased was recorded in F_0 (10.96%) proceeded by F_3 (9.34%) whereas the minimum decreased was recorded in F_2 (6.04%) proceeded by F_5 (6.21%).

Table 11: *Taste of the cookies.*

Formulations	Storage intervals (Months)				Mean	% Dec
	0	1	2	3		
F_0	7.00	6.90	6.78	6.60	6.82 B	5.71
F_1	7.00	6.89	6.80	6.67	6.84 B	4.71
F_2	7.20	7.10	7.00	6.85	7.04 A	4.86
F_3	6.80	6.70	6.58	6.47	6.64 C	4.85
F_4	6.60	6.50	6.38	6.26	6.44 D	5.15
F_5	6.40	6.28	6.17	6.10	6.24 E	4.69
F_6	6.20	6.10	6.00	5.85	6.04 F	5.65
Mean	6.74A	6.64B	6.53C	6.40C		

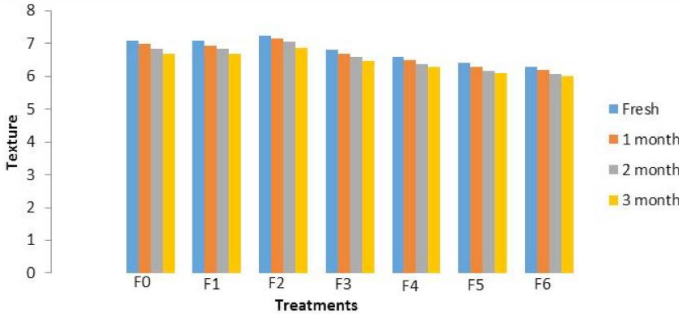

Figure 9: *Effect of texture during storage on wheat and maize based cookies.*

The statistical application indicated that treatment effect and the storage intervals had a significant effect ($p<0.05$) on color of the cookies. The analyzed data regarding the color of the cookies was similar to the data of Waheed et al. (2010) that carried out the research work on the effect of cottonseed and palm oil blends on the quality of cookies. Hussien et al. (2006) also reported gradual decreased in color for cookies during the storage period.

Table 12: *Texture of cookies.*

Formulations	Storage intervals (Months)				Mean	% Dec
	0	1	2	3		
F_0	7.10	7.00	6.85	6.70	6.91 B	5.63
F_1	7.10	6.95	6.85	6.70	6.90 B	5.63
F_2	7.25	7.15	7.05	6.87	7.08 A	5.24
F_3	6.82	6.70	6.60	6.47	6.65 C	5.13
F_4	6.61	6.50	6.38	6.30	6.45 D	4.69
F_5	6.41	6.30	6.18	6.09	6.25 E	4.99
F_6	6.30	6.20	6.08	6.00	6.15 F	4.76
Mean	6.80A	6.69B	6.57C	6.45D		

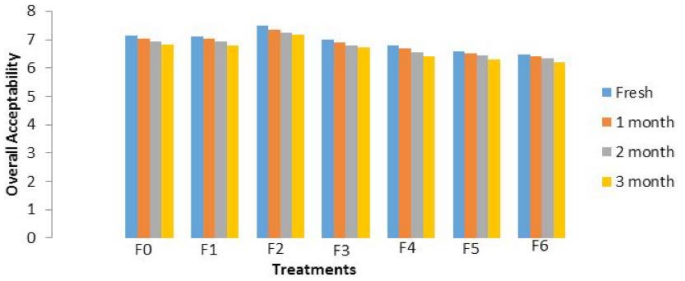

Figure 10: *Effect of overall acceptability during storage on wheat and maize based cookies.*

Taste: The mean score of judges for the taste were presented in Table 11. The mean score of judges for the taste of freshly prepared cookies ($F_0 - F_6$ stored for three months) were 7.00, 7.00, 7.20, 6.80, 6.60, 6.40 and 6.20 respectively. The score after one month were 6.90, 6.89, 7.10, 6.70, 6.50, 6.28 and 6.10, while after second month the mean score were 6.78, 6.80, 7.10, 6.58, 6.38, 6.17 and 6.00, after the third month the score of cookies were 6.60, 6.67, 6.85, 6.47, 6.26, 6.10 and 5.85. The overall mean score of judges for the taste of cookies significantly ($p<0.05$) decreased from 6.74 to 6.40 during three months evaluation. Maximum mean score was recorded in F_2 (7.04) proceeded by F_1 (6.84) whereas the minimum mean score was recorded in F_6 (6.04) proceeded by F_5 (6.24). During the storage maximum decreased was recorded in F_0 (5.71%) proceeded by F_6 (5.65%) whereas the minimum decreased was recorded in F_5 (4.69%) proceeded by F_1 (4.71%).

The statistical application indicated that treatment effect and storage intervals had a significant effect ($p<0.05$) on the taste of the cookies. The analyzed data regarding the taste of the cookies was similar to the data of Jia et al. (2011) reported that due to rapid staling, bakery products converting the flavor and aroma to off flavor. Waheed et al. (2010) carried out the research work on the effect of cottonseed and

palm oil blends on the quality of cookies and analyzed the same results.

Texture: The mean score of judges for the texture were presented in Table 12. The mean score of judges for the texture of fresh prepared cookies (F_0 – F_6 stored for three months) were 7.1, 7.1, 7.25, 6.82, 6.61, 6.41 and 6.30 respectively. The score after one month were 7.00, 6.95, 7.15, 6.70, 6.50, 6.30 and 6.20, while after second month the mean score were 6.85, 6.85, 7.05, 6.60, 6.38, 6.18 and 6.08, after the third month the score of cookies were 6.70, 6.70, 6.87, 6.47, 6.30, 6.09 and 6.00. The overall mean score of judges for texture of cookies significantly ($p<0.05$) decreased from 6.80 to 6.45 during three months evaluation. Maximum mean score was recorded in F_2 (7.08) proceeded by F_0 (6.91) whereas minimum mean score was recorded in F_6 (6.15) proceeded by F_5 (6.25). During the storage maximum decreased was recorded in F_0 and F_1 (5.63%) proceeded by F_2 (5.24%) whereas the minimum decreased was recorded in F_4 (4.69%) proceeded by F_6 (4.76%).

The statistical application indicated that treatment effect and the storage intervals had a significant effect ($p<0.05$) on texture of the cookies. The analyzed data regarding the texture of the cookies was similar to the data of Sharif et al. (2005) stated that the diminishing trend for texture was possibly due to moisture uptake from the environment that has inverse relation with the texture. Waheed et al. (2010) carried out the research work on the effect of cottonseed and palm oil blends on the quality of cookies and analyzed the same results.

Overall acceptability: The mean score given by judges for the overall acceptability were presented in Table 13. The mean score of fresh cookies (F_0 – F_6 stored for three months) were 7.15, 7.12, 7.50, 7.00, 6.80, 6.60 and 6.50 respectively. The score after one month were 7.05, 7.03, 7.35, 6.90, 6.71, 6.51 and 6.42, while after second month the mean score were 6.94, 6.93, 7.26, 6.80, 6.56, 6.44 and 6.33, after third month the score of cookies were 6.82, 6.80, 7.18, 6.72, 6.43, 6.32 and 6.21. The overall mean score of cookies significantly ($p<0.05$) decreased from 6.95 to 6.64 during three months evaluation. The maximum score was recorded in F_2 (7.32) proceeded by F_0 (6.99) whereas the minimum score was recorded in F_6 (6.37) proceeded by F_5 (6.47). During the storage maximum decreased was recorded in F_4 (5.44%) proceeded by F_0 (4.62%) whereas the minimum decreased was observed in F_3 (4.00%) proceeded by F_5 (4.24%).

Table 13: *Overall acceptability of cookies.*

Formulations	Storage intervals (Months)				Mean	% Dec
	0	1	2	3		
F_0	7.15	7.05	6.94	6.82	6.99 B	4.62
F_1	7.12	7.03	6.93	6.80	6.97 B	4.49
F_2	7.50	7.35	7.26	7.18	7.32 A	4.27
F_3	7.00	6.90	6.80	6.72	6.86 C	4.00
F_4	6.80	6.71	6.56	6.43	6.63 D	5.44
F_5	6.60	6.51	6.44	6.32	6.47 E	4.24
F_6	6.50	6.42	6.33	6.21	6.37 F	4.46
Mean	6.95A	6.85B	6.75C	6.64D		

The statistical application indicated that treatment effect and storage intervals had a significant effect ($p<0.05$) on the overall acceptability of cookies. The analyzed data regarding overall acceptability of the cookies was similar to the data of Pasha et al. (2011) reported decreasing trend in the overall acceptability for legume cookies. Kamaljit et al. (2010) also analyzed that the overall acceptability for the pea flour incorporated cookies decreased with enrichment.

Conclusions and Recommendations

The overall analyses indicated that the cookies prepared from formulation F_2 (80% wheat and 20% maize flour incorporation) give best result. The results suggested that further study should be carried out by using different flavor to increase the acceptability of the cookies. Furthermore, special packaging materials should be used for storage of cookies.

Author's Contribution

Kashif Akbar: Conceived the idea, conducted the research, did experments and statistical analysis and wrote the manuscript.
Muhammad Ayub: Planned, designed and supervised the research, did statistical analysis and corrected the manuscript.

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