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Ready To Bake Multigrain Cookies

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Abstract: Traditional cookies are ready to eat and the most palatable snack product widely available in the market. These cookies are low in protein and dietary fibres. Also, the preparation of fresh cookies at home is a tedious and time-consuming process. Therefore, an attempt was made to prepare ready-to-bake multigrain cookies with a high protein and fibre content. These ready-to-bake cookies will be available in the market in the form of frozen unbaked cookies that only have to be baked at home so that the consumers will get freshly baked cookies with increased nutritional value. In this study, barley flour (BF) and cornflour (CF) were incorporated with refined wheat flour (RWF) in various proportions. The incorporation of barley increases the protein, fibre and adds beta-glucan to cookies which is very beneficial for health, while corn flour improves the taste and texture of the multigrain cookies. Therefore, five different formulations for ready-to-bake cookies were prepared, i.e. S1 (RWF: BF: CF :: 70: 20: 10), S2 (RWF: BF: CF:: 60: 30: 10), S3 (RWF: BF: CF:: 50: 40: 10), S4 (RWF: BF: CF:: 40: 35: 25), and S5 (RWF: BF: CF:: 30: 30: 40). Based on the physicochemical and sensory evaluation of baked cookies, Sample S4 was found the most acceptable. The unbaked cookies of Sample S4 were then stored at freezing temperature -18°C in the deep freezer. The sensory characteristics of the frozen stored cookies (after baking) were studied at an interval of 15 days for about three months of frozen storage. No significant changes have appeared in the quality of ready-to-bake cookies during frozen storage. Thus, this study's outcome will help in development of healthy multigrain cookies, which can be baked at home in a few minutes.

Keywords: frozen storage, multigrain cookies,nutrition, physicochemical evaluation, sensory evaluation

I. INTRODUCTION

Development of new features in the product or the development of the new product that can satisfy public demands is the basic strategy of the food industry [1].Nowadays, due to hectic life, people have been demanding ready-to-cook foods that are easy to prepare, take less timein cooking, are healthy, have a good shelf life, and havea good taste [2]. So, in this study, all these attractive features are tried to incorporate into the cookie. Cookies are processed food that all sections of people highly eat as a snack [3]. It is generally round, flat, and small. It is available in many flavours. The primary ingredients are flour, fat, sugar, salt, and water,depending on the type. Its production is vast and available worldwide [4].

In this study, the cookie was prepared where refined wheat flour was substituted with barley and corn flour in five different ratios. Barley is a high nutritional grain as it contains β-glucan, B-complex vitamins, tocotrienols, tocopherols and has significant antioxidant potential [5]. It is better than wheat and rice as it has more phenolic compounds and antioxidant activity [6]. Many studies have shown that barley flour has high dietary fibre content and a high proportion of soluble fibre, especially β-glucan. Soluble fibre and insoluble fibre have many health benefits as it helps lower plasma cholesterol, improves lipid metabolism, reduces glycemic index, boosts the immune system, and reduce the risk of colon cancer [7]. In barley, most free phenolics are flavanols and tocopherols, whereas the

bound phenolics are mainly phenolic acids (ferulic acid and pcoumaric acid) [8]. Due to so many benefits, it is beneficial from the nutritional and functional point of view.

Corn or maize is a significant source of carbohydrates, protein, vitamin B, vitamin A, and minerals [9].In many countries, corn is the main food cereal, and its products are used in a wide range of foods. One of the corn products is corn flour, and it is not desired product of a dry corn mill. However, it is highly used in baked goods. Due to the high content of fat and β-carotene, it imparts flavour and colour to baked goods and can also be used as an economic, nutritive, and tasty additive [10]. It has a yellow colour, and when blended with wheat flour, it gives a rich appearance to baked goods. The addition of corn flour to baked goods prepared with wheat flour reduces the tendency for shrinkage [11]. Also, cookies prepared with water-treated corn flour produced cookies with an increased diameter and improved top grain. It is also an alternative product for individuals with coeliac disease. The amino acid in corn, leucine, is vital in the incidence of pellagra. [12]

Frozen storage technology now days highly used in ready-to-make foods. In this technology, the raw or pre-processed food is stored at low temperature, generally at -18 °C, and packed in a polymer film. At such a temperature, the metabolic activities run at a slower rate which increases the shelf life of food; also, at this temperature, the microbial infestation becomes negligible, which prevents the damaging of food.[13]. In this study, this technology was used where the unbaked cookies of selected composition wereprepared and stored at -18 °C in fresh wraps, baked and taken for sensory evaluation. This was done at an interval of 15 days for up to three months.

So, the research attempted to assess cookie's physical, chemical, and sensory properties improved with barley and corn flour at different substitution levels. Also, analysed the sensory attributes of baked cookies stored under freezing conditions in unbaked frozen form.

II. MATERIALS AND METHODOLOGY

A. Materials

Refined wheat flour (Shaktibhog), corn flour (Tops), barley flour (Curry Patta), plain butter (Amul), cane sugar (BB Royal), and baking powder (Ajanta) were used as raw materials. Analytical Research (AR) grade chemicals (high-grade chemicals suitable for different analyses) were used to analyse the raw materials and final products.

B. Experimental design

This study used Design Expert software version 13 of Stat-Ease Company and D-optimal mixture design, from which five random compositions were selected for cookies preparation. The ingredients and their respective amountused in the formulation of five different cookies are presented in the table I.

Table I: The ingredients and their amount used in the formulation of different samples

Ingredients	Amount of ingredients used in different samples				
	S1	**S2**	**S3**	**S4**	**S5**
Refined wheat flour (RWF) (g)	70	60	50	40	30
Corn flour (CF) (g)	10	10	10	25	40
Barley flour (BF) (g)	20	30	40	35	30
Sugar (g)	30	30	30	30	30
Butter (g)	50	50	50	50	50
Baking powder (g)	1.5	1.5	1.5	1.5	1.5
Water (ml)	30	30	30	30	30

C. Preparation of cookies

Cookies were prepared by modifying the method described by Das et al.[3] . Firstly, the butterand grounded sugar were added to the dough mixer bowl (creaming). After that, the flours, baking powder, and water were added in the proper amount into the mixture and kneaded well to produce dough. Then the dough was rolled into a thin uniform sheet. The thickness of the sheet was about 5mm. After sheeting, the sheet was cut out into pieces using a cookie cutter of 5.3 cm diameter. Then the cookies were placed on an aluminum tray greased with butter. The tray was then placed in the baking oven preheated at 180 °C and baked for about 15-20 minutes. The prepared cookies were cool down to room temperature, packed in plastic film, and stored at ambient temperature for further use. The flowchart for the production of cookies is given in figure 1. All different cookies were evaluated for nutritional and sensory attributes. After the evaluation, cookies of the selected formulation were prepared, placed in the plastic box lined with butter paper, and stored in the freezer for about 30 min. After that,the box was taken out; cookies were separately packed in different fresh wraps. One fresh wrap contains six frozen unbaked cookies; all fresh wraps were stored in a single box and kept in a deep freezer maintained at -18 °C. After every 15 days, two pieces were taken out and baked at 180 °C for 20-25 minutes. During baking, first, they are baked at a slightly low temperature to lower the temperature difference, and then the temperature increases to 180 °C. After baking, they were undergone for sensory evaluation. This process has been done for about three months.

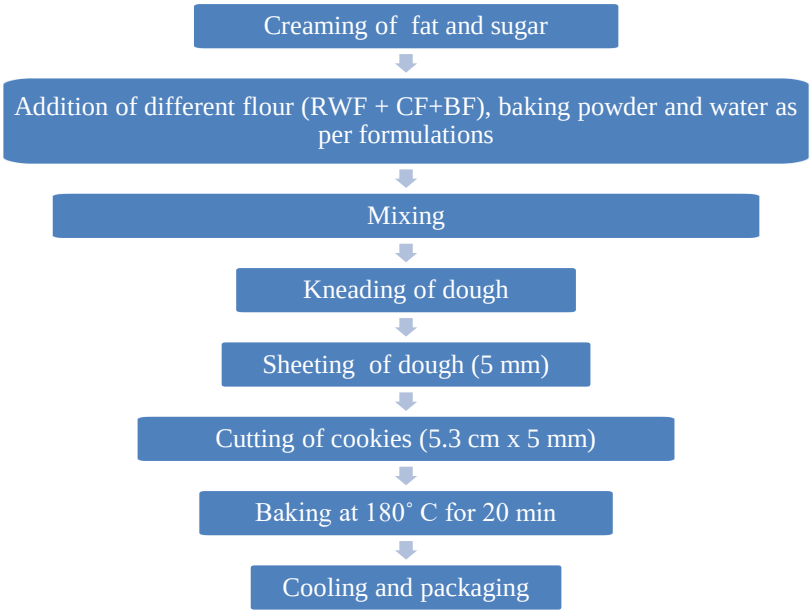

Figure1: Outline of cookies preparation

D. Nutritional analysis of flours and cookies

Flours and processed cookies were analysed for moisture, ash, protein, fat, dietary fibre, and total carbohydrate content. All the calculations were done in triplicate, and the results were given as the average value ± standard deviation. The moisture and ash content of the samples was estimated using an air oven and muffle furnace[14]. Protein content, fat, and dietary fibre were estimated using the Kjeldahl, Soxhlet, and Acid-Base method [15]. Carbohydrate content was calculated by subtracting the measured fat, protein, ash, fibre, and moisture from 100. [Carbohydrates = 100 - (%Protein + %Moisture + %Ash + %Lipids + %Fibre)].[16]

E. Physical analysis

The dough and prepared cookies were analysed for strength, thickness, diameter, spread factor, and spread ratio. All the calculations were done in triplicate, and the results were given as the average value ± standard deviation.

1) Physical analysis of dough

1.1) Dough strength

The strength of all doughs has been determined by using a texture analyzer. (TA.XT Express ENHANCED Stable MicroSystems, Vienna Court, Lammas Rd, Godalming GU7 1YL, United Kingdom). Each dough was placed on the loading cell and compressed as per the standard procedures given by H. Mamat and S. E. Hill.[17]

2) Physical analysis of cookies

2.1) Diameter

The total diameter of cookies was measured by placing cookies edge to edge, and the scale was placed horizontally along the diameter [4].

Average diameter= total diameter/total no. of cookies

2.2) Thickness

The average thickness value was obtained by dividing the total thickness by the number of cookies. Total thickness was measured by stacking all the cookies and then placing the scale from top to bottom, and the total thickness was measured [3].

2.3) Weight

The weight of the individual cookie was calculated by using a digital weighing balance. [3]

2.4) Spread-ratio

It was calculated by dividing the average diameter bythe average thickness.

Spread ratio = Diameter / Thickness[3]

2.5) Spread factor

It was calculated by dividing the spread ratio of cookies before baking by the spread ratio of cookies after baking[18].

Spread factor = spread ratio of cookies before baking / spread ratio of cookies after baking.

F. Sensory evaluation

All cookie samples contain various proportions of RWF, BF, and CF. For the hedonic rating test, they underwent sensory evaluation by 10-panel members, as mentioned by Ranganna [15]. The panelists were the teachers and employees of the Department of Food Technology. They have given a chart with the sample numbers and attributes mentioned on it. Panel members gave one cookie from each lot as randomly coded samples. They rate the cookies on a 9–point hedonic scale for appearance, colour, taste, flavour, crispiness, and overall acceptability. The ratings were: 9=like extremely, 8=like very much, 7=like moderately, 6=like slightly, 5= neither like nor dislike, 4=dislike slightly, 3=dislike moderately, 2=dislike very much, 1=dislike extremely[3]. Values in the result were given as average±standard deviation. The sample having the desired nutritional and sensory characteristics was stored at -18 °C. Frozen unbaked cookies of the sample after baking were also evaluated using 9 point hedonic scale at an interval of 15 days for about three months.

G. Statistical analysis

The obtained data were analysed for standard deviation, single factor Analysis of Variance (ANOVA) using Microsoft Office Excel 2013[3].

III. RESULTS AND DISCUSSIONS

A. Nutritional analysis of flours

RWF, BF, and CF were analysed for moisture, protein, fat, ash, fibre,and total carbohydrate content. The results are shown in Table II.

B. Physical analysis of dough

1) Dough strength

The dough of all the samples was evaluated for strength, and the results are presented in Table III. From the result, it was observed that dough strength was directly proportional to gluten content, i.e., wheat content. S1 has the highest quantity of refined wheat flour (70%), so it has the highest dough strength (4727.3g), while S5 has the lowest quantity of refined wheat flour (30%), so it has the lowest value of dough strength (2798.5g).

C. Physical analysis of cookies

The prepared Cookies were analysed for diameter, thickness, weight, spread ratio, and spread factor. The results are shown in Table IV.

1) Diameter

The diameter of all cookies was almost the same, about 5.3 cm before baking, but after baking, it differs. This can be due to the barley and corn flour. As per studies, corn flour increases diameter, probably due to gluten dilution with gluten-free flour[19]. In contrast, barley decreases diameter due to high fibre[20]. In a similar report, it was given that the size of barley cookies decreased due tothe dough's higher fibre and protein content[21],[22],[23]. In another report, reduced spreading characteristics of cookies were observed due to high fibre oat β-glucanhydrocolloid[24].

2) Thickness

Before baking, the average height of all cookies wasabout 0.7cm. After baking, it showed some differences. The results revealed that barley flour causes an increase in thickness while cornflour results in lowering it. Similar findings were given in a report, where high fibre increased thickness caused a reduction in the size of the barley cookies[20], [21]. However, the addition of cornflour did not significantly influence the increase in thickness due to baking[19].

3) Weight

The weight of a cookie ranges from 16-20 gm. The difference in weight was maybe because of inconsistent rolling which was done manually.

4) Spread ratio

It is one of the most crucial quality parameters of the cookie. A higher spread ratio is desirable. It is highly influenced by the ingredients used in the product's formulation. The spread ratio of all samples before baking was about 7.57, after baking, its value showed some changes. The spread ratio of S2 and S3 decreasesupon the barley flour incorporation, which might be due to the absorption of water molecules by the hydrophilic compounds present in the barley that increases the viscosity of dough and make it spread less. An increase in fibre content retarded the spreading of cookies, thus reducing the diameter with a subsequent increase in thickness of cookies[25]. S4 and S5 have higher values due to higher corn flour addition. Similar findings were given in a report where 15% supplemented biscuits gave the minimum spread ratio, but the value increased with more addition of CF[3]. The additional fat component contributed by cornflour could have positively affectedthe spread ratio[26].

5) Spread factor

The spread factor also reflects the quality of the product. It shows the differences obtained in cookies prior to and after baking. Higher values of this parameter are appreciated owing to a positive influence on the acceptability of biscuits[27].

D. Nutritional analysis of cookies

The prepared cookies were analysed for moisture, fat, protein, ash, fibre, and carbohydrate content. The results are shown in Table V.

1) Moisture

The moisture content of different cookie samples was in the range of 2.920-4.560%. The variations in moisture contents in cookies might be due to the difference in initial moisture content of different flour, the quantity of flours mixed, and subsequent storage conditions. All cookies have moisture content within the limit, which reduces the chances of getting infected or spoiled by microbes that ensure good storage stability. The S5 sample has the lowest 2.920%, while S2 has the highest 4.560% moisture content.The difference in moisture content observed with the addition of barley flour is probably because of the higher water-holding capacity of barley flour[21]. The moisture content of composite biscuits reported was in the range of 5.13–7.17%[28], whileanother report reported moisture content of 3.80–4.62% in corn-fenugreek composite biscuits[29]. Biscuits formulated with blended soy flour and WF gave moisture content from 4.75 to 5.32% (wb)[30]. The moisture content in cookie samples were almost in range with those reported by other authors.

Table II: Nutritional analysis of flours

Component(%)	Flours		
	Wheat flour	Barley flour	Corn flour
Moisture	9.02±0.65	10±0.75	9.4±0.94
Protein	12.45±0.23	20±0.38	0.40±0.21
Fat	0.28±0.06	1.0±0.05	0.00±0.07
Ash	0.66±0.10	1.30±0.16	0.45±0.10
Dietary fibre	2.97±0.03	9.7±0.02	0.00±0.06
Carbohydrate	74.62±0.98	58±1.35	89.75±1.17

*Values are the mean ± standard deviation of the triplicates.Mean values do not differ significantly at the 5% level of significance($p>0.05$).

Table III: Strength of different doughs of respective samples

Sample dough	Dough Strength (g)
S1	4727.3±17.50
S2	3000.3±25.54
S3	3242.3±19.63
S4	2916.1±20.19
S5	2798.5±15.67

*Values are the mean ± standard deviation of the triplicates. Sample S1 = 70% RWF+20%BF+10%CF; S2 = 60%RWF + 30% BF+10%CF; S3= 50% RWF + 40% BF +10%CF; S4= 40% RWF + 35% BF + 25%CF; S5= 30% RWF + 30%BF + 40%CF

Table IV: Physical parameters of cookies after baking

Samples	Diameter (cm)	Thickness (cm)	Spread ratio	Spread factor
S1	5.3±0.010	1.05±0.016	5.04±0.532	1.50±0.313
S2	5.2±0.011	1.11±0.018	4.68±0.324	1.61±0.173

S3	5.1±0.062	1.15±0.012	4.43±0.281	1.70±0.056
S4	5.3±0.041	1.12±0.016	4.73±0.184	1.60±0.122
S5	5.4±0.023	1.00±0.026	5.40±0.594	1.40±0.329

*Values are the mean ± standard deviation of the triplicates. Mean values do not differ significantly at 5%level of significance (p>0.05). Sample S1 = 70% RWF+20%BF+10%CF; S2 = 60%RWF + 30% BF+10%CF; S3= 50% RWF + 40% BF +10%CF; S4= 40% RWF + 35% BF + 25%CF; S5= 30% RWF + 30%BF + 40%CF.

Table V: Nutritional analysis of cookies

Component	Samples				
	S1	**S2**	**S3**	**S4**	**S5**
Moisture	2.950±0.07	4.560±0.06	3.630±0.05	3.670±0.03	2.920±0.02
Protein	7.666±0.03	8.186±0.06	8.911±0.03	7.569±0.05	6.277±0.03
Fat	22.870±0.05	22.552±0.04	22.816±0.08	22.757±0.02	22.881±0.05
Ash	0.780±0.04	0.524±0.03	0.974±0.07	1.373±0.05	0.370±0.04
Dietary fibre	2.986±0.03	3.663±0.02	4.429±0.04	3.811±0.03	3.220±0.05
Carbohydrate	62.748±0.15	60.516±0.12	59.240±0.13	60.820±0.10	64.332±0.14

*Values are the mean ± standard deviation of the triplicates. Meanvalues do not differ significantly at the 5% level of significance(p>0.05).Sample S1 = 70% RWF+20%BF+10%CF; S2 = 60%RWF + 30% BF+10%CF; S3= 50% RWF + 40% BF +10%CF; S4= 40% RWF + 35% BF + 25%CF; S5= 30% RWF + 30%BF + 40%CF.

Table VI: Mean score for appearance, colour, flavour, taste, crispiness, and overall acceptability of composite cookies

Sample No.	Sensory Attributes					
	Appearance	**Colour**	**Flavour**	**Taste**	**Crispiness**	**Overall Acceptability**
S1	7.5±0.670	7.4±0.916	7.5±0.806	7.4±0.800	7.3±0.640	7.5±0.670
S2	7.3±0.458	7.3±0.781	7.1±0.538	7.2±0.748	7.2±0.600	7.3±1.004
S3	7.2±0.748	7.1±0.700	6.9±0.830	6.7±0.781	7.1±0.871	6.9±0.700
S4	7.4±0.916	7.5±0.500	7.8±0.600	7.7±0.458	7.0±0.894	8.0±0.774
S5	7.0±0.774	6.8±0.600	7.2±0.871	7.3±0.781	6.5±0.500	7.2±0.400

*Values are the mean ± standard deviation. Mean values differ significantly at 5% level of significance (p<0.05). Sample S1 = 70% RWF+20%BF+10%CF; S2 = 60%RWF + 30% BF+10%CF; S3= 50% RWF + 40% BF +10%CF; S4= 40% RWF + 35% BF + 25%CF; S5= 30% RWF + 30%BF + 40%CF.

Table VII: Mean score of appearance, colour, flavour, taste, crispiness, and overall acceptability of cookie S4

	Sensory attributes					
Storage period(days)	**Appearance**	**Colour**	**Flavour**	**Taste**	**Crispiness**	**Overall Acceptability**
O day	7.4±0.489	7.5±0.806	7.8±0.400	7.7±0.640	7.0±0.774	8.0±0.894
15th day	7.4±0.663	7.5±0.921	7.8±0.748	7.7±1.004	7.0±0.632	8.0±0.447
30th day	7.4±0.916	7.5±1.024	7.8±0.632	7.7±0.781	7.0±0.447	8.0±0.632
45th day	7.4±1.113	7.5±0.916	7.8±0.894	7.7±0.900	7.0±0.774	7.9±0.538
60th day	7.4±0.458	7.5±1.200	7.8±0.632	7.7±1.268	7.0±0.894	7.9±0.830
75th day	7.3±0.640	7.5±1.024	7.7±1.187	7.6±0.663	6.8±0.748	7.8±0.748
90th day	7.3±0.600	7.5±0.806	7.7±0.640	7.6±0.489	6.8±0.600	7.7±1.100

*Values are the mean ± standard deviation .Mean values do not differ significantly at 5% level of significance (p>0.05)

2) Protein

The protein content of the samples was in the range of 6.277-8.911%. Sample S3 has the highest protein content, 8.911%, and sample S5has the lowest, 6.277%. This might be due to barley flour's protein content, which is the highest, and cornflour has a negligible protein. Similar results were given in by Hussain et al.[3] where an increase in cornflour lowers the protein content of the samples. Another observation supports the result by reporting that malted barley flour increment successively increases the protein content of the cookies[4].

3) Fat

All cookie samples were prepared withthe same amount of fat; however, the results showed slight variation. It was in the range of 22.552-22.881%. It increases with the supplementation of corn and barley flour. Similar findings were given, where the fat content increased with the supplementation of cornflour[3]. Ikuomola et al. [4] also observed that the fat content of the cookies increased significantly as the substitution level of malted barley bran increased from 5 to 50%. A similar report was observed by Hussain and Kaul[31] where the crude fat content increased from 20.82 to 23.65% with the incorporation of buckwheat and barley flour.

4) Ash

Ash states the inorganic material of the product. The results showed that wheat flour supplementation with barley and cornflour increases mineral content. It was in the range of 0.370-1.373%. Sample S4 has the highest mineral content. This could be due to all three flours contributing an average amount. The addition of barley flour significantly increased the ash content of the cookies[4]. Agu et al.[32] gave similar results like the ash was found in the range of 0.99 to 1.13% (wb) in a composite biscuit, while Seevaratnam et al.[33] observed 1.4% ash in the control biscuit and 1.7% ash in 20% potato flour containing composite biscuit.

5) Dietary Fibre

The fibre content was in the range of 2.986-4.429%. The fibre content of barley flour is more than wheat flour and corn flour, resulting in the high amount of fibre in the samples having a high amount of barley flour. Thus the fibre content of sample S3 was the highest, 4.429%. Similar results were given by Ikuomola et al.[4] where the fibre content increases with the substitution of malted barley. Hussain and Kaul[31] also found higher fibre content in the samples having a high amount of buckwheat and barley flour.

6) Carbohydrate

The Carbohydrate content of all samples was different due to the difference in fat, moisture, ash, fibre, and protein content of all samples. The carbohydrate was in the range of 59.240-64.332%. Carbohydrate content increases with the cornflour content and decreases with the barley flour content. Thus sample S3 has the highest barley flour content, so has the lowest carbohydrate, and sample S5 has the highest cornflour content, so it has the highest carbohydrate percent. Many authors gave similar observations. Das et al.[3] observed that the carbohydrate content increased with the corn flour increment, and the carbohydrate content was found in the range of 68.86–69.94%. Ikuomola et al. [4] found a decrease in the carbohydrate content when the malted barley bran increased in the cookies.

E. Sensory evaluation of cookies

The hedonic rating test has been used for the analysis of cookies. Results are shown in Table VI, and a graphical presentation of the results is shown in figure 2.The analysis showed that all cookie's appearance was different from each other. Appearance becomes dull with the incorporation of barley; it makes the surface coarser, which may be due to more fibre content. The colour of all cookies differs from each other; it develops due to Maillard's reaction and caramelization. S1 has an appearance similar to the cookie of refined wheat flour. Sample S4 has the proper colour due to the adequate amount of barley and cornflour. S5 has the darkest colour due to the high barley and corn flour, thus having the lowest score. A report studied that cookies with 30 and 40% substitution with barley flour

were darker than the other cookies[21]. Also, as per a study, high corn quantity develops darker colour in biscuits due to high sugar content[19]. The flavour and taste of all cookies were foundinthe acceptable range, and the taste of S4 was appropriate among all the samples. The hardness of cookies decreases with barley and cornflour. Similar results were given by Pasqualone et al.[19] and Frost et al.[21] where barley addition of upto 30-40% decreases its hardness, and cornflour increment makes the cookies very fragile. Sample S4 has the proper hardness due to the adequate amount of barley and corn flour. So, sample S4 was found to have the highest overall acceptability score, and sample S3 was the lowest.

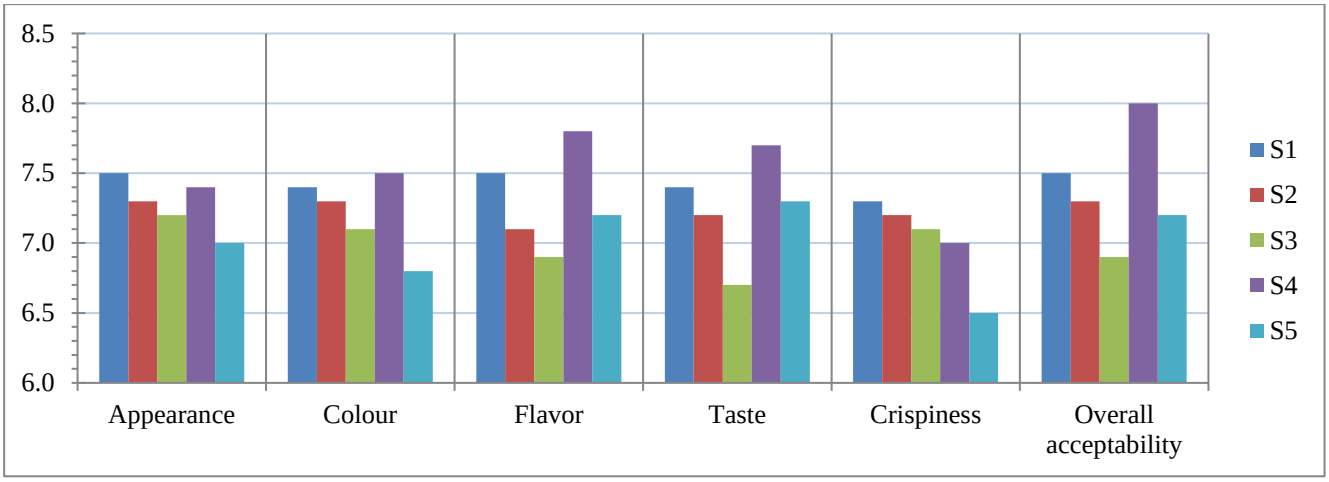

Figure 2: Graphical presentation of the mean sensory score of composite cookies

Sample S1 = 70% RWF+20%BF+10%CF; S2 = 60%RWF + 30% BF+10%CF; S3= 50% RWF + 40% BF +10%CF; S4= 40% RWF + 35% BF + 25%CF; S5= 30% RWF + 30%BF + 40%CF.

F. Sensory evaluation of frozen unbaked cookies

Raw unbaked cookies of S4 were stored at a temperature of -18 °C. After every 15 days, two pieces of the sample were baked. After baking, cookies were sensory evaluated using 9 point hedonic rating test. This has been done for about three months. Results showed that the Sensory attributes of cookies do not differ much with timeand givesatisfactory results. Results are shown in Table VII and graphical presentation of the scores were shown in figure 3.

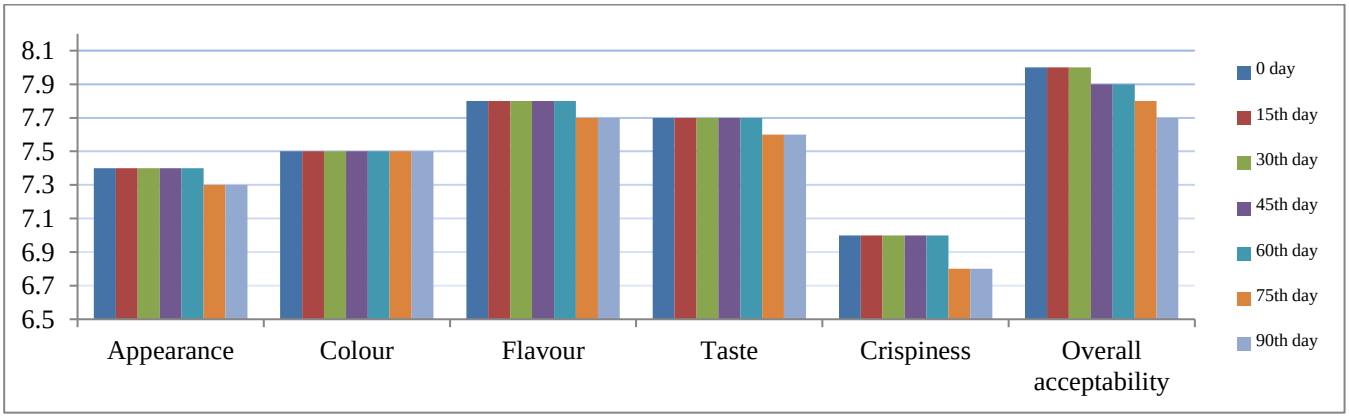

Fig.3 Graphical presentation of mean sensory scores of cookie S4.

(S4= 40% RWF + 35% BF+ 25%CF)

IV. CONCLUSION

The results showed that barley and cornflour made it possible to produce nutritious, delicious, and ready-to-bake cookies. All the cookie samples were nutritionally sound, but S4,with the nutrition value, had good consumer liking, too, so it was the desired sample. As cookies were multigrain, they were able to fulfill the needs of the skeletal section of the population of many countries like India. Moreover, the study found that cookies can be kept for at least three months under freezing conditions, so people can keep them for at least three months and eat them at home any time without any delay. So with the help of this research, further study can be done on underutilized flours that have good nutritional content and can be used as an ingredient in ready-to-bake cookies.

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