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Formulation and quality evaluation of multigrain cookies

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Abstract
The present research work was designed to formulation and quality evaluation of multigrain cookies (Refined-wheat flour, corn flour and kodo millet flour). The aim of this research work was to study the quality evaluation of the cookies. The seven sample T0, T1, T2, T3, T4, T5 and T6 were developed by refined-wheat flour, corn flour, kodo millet flour and butter, sugar, milk powder, baking powder was also incorporated. The prepared cookies were packed in LDPE (Low-density polyethylene) and stored at ambient temperature (30±4 °C) for 45 days. The prepared cookies were subjected to chemical and sensory analysis. The chemical analysis of the fresh cookies Showed that moisture content % between 3.56-4.18%, ash content 0.92- 1.49%, protein content 11.86- 13.41%, reducing sugar content 89.85-85.79%, fat content 22.32-20.30% and fibre content 0.83-1.61% The result of sensory (appearance, taste, flavour, texture, colour and overall acceptability) was evaluated by five point hedonic-scale and it was done by the panellist members. The overall acceptability was determined by chemical analysis (Moisture, Ash, Fat, protein, Fibres) sensory evaluation and microbial analysis, sample T0, T1, T2, T3, T4, T5 and T6 with 6.8%, 6.7%, 6.4%, 6.7%,6.2%, 6% and 7.3% and sample T6 was found to be satisfactory.

Keywords: refined-wheat flour, corn flour, kodo millet flour, cookies, LDPE, moisture, ash, protein, reducing sugar, fat, fibre, sensory evaluation

Introduction
Baking industry currently occupies the major segment of the food process industries in India with annual turnover of about Rs.37,000crores. In past few years this is consumed by maximum population mainly due to its ready-to-eat nature, satisfactory nutritional quality, availability of different varieties such as cookies, bread and buns, rusk and toast, bagles, loaf breads, muffins, cake, chips and namkeen are highly demanding by consumers in these days. These foods are often called functional foods (Jha *et al.,*2018).

Cookies are widely consumed by all level of society due to their rich carbohydrates, fat and calories value. The cookies formula consists of refined wheat flour, hydrogenated fat, sugar and other additives (Mitkal *et al.,* 2021) [4]. The refined flour lack in dietary fibre and micronutrients which are important for health promoting components (Mitkal *et al.* 2021) [4]. Cookies quality can be enhanced by quantitively and qualitatively blending of nutritional millet flour such as pearl millet flour, finger millet flour and kodo millet flour in a proximate amount.

Millet have been in food use since time immemorial and an array of traditional foods are prepared across rural India. Among the millet kodo millet (*Paspalum scrobiculatum*) is an important underutilized grain, also called as *kodra, varagu, haraka, arakalu,* and Japanese kodo millet (Mitkal *et al.,* 2021) [4]. kodo grains contain protein (8.35%), fat (1.45%), carbohydrates (65.65%) and ash (2.95%) (Chaturvedi *et al.,*2019).

Corn flour (*Zea mays*) can be used in baked goods as an economic, nutritive and tasty additives (Bilgicil *et al.,* 2006) [3]. The particular amino acid in corn, leucine, is important in incidence of pellagra (Bilgicil *et al,* 2006) [3]. In bakery industries corn starch are used as thickening agent and it gave structure to baked goods and other foods. Addition of corn flour to baked goods prepared with wheat flour reduces tendency for the shrinkage (Badi *et al,* 1978).

Kodo millets (*Paspalum scrobiculatum*) is rich in vitamins, minerals, fibre and proteins (glutelin), so it is called "nutri-cereals" and formulation of multigrain cookies from kodo millets and rich in fibre content and it can be considered as healthy food.

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Material and Methods

Procurement of Raw Materials: The raw material required for the cookie's preparation (Refined-wheat flour, corn flour, kodo millet flour, milk powder, shortening, sugar, Leavening agent, Sugar) was procured from local market of Lucknow

Table 1: Formulation

Ingredients	Sample (T0)	Sample (T1)	Sample (T2)	Sample (T3)	Sample (T4)	Sample (T5)	Sample (T)6
Refined wheat flour	100 g	80g	80g	80g	60g	60g	60
Corn flour	−	10g	15g	5g	20g	30g	10g
Kodo flour	−	10g	5g	15g	20g	10g	30g
Shortening (Butter)	50g	50g	50g	50g	50g	50g	50g
Sugar	25g	25g	25g	25g	25g	25g	25g
Milk powder	5g	5g	5g	5g	5g	5g	5g
Baking powder	1g	1g	1g	1g	1g	1g	1g

Methods

The recipe for multigrain cookies was developed using different ingredients such as refined wheat flour, corn flour, kodo millet flour, milk powder, Leavening agent and sugar. For the preparation of cookies specific proportion of kodo millet flour was taken for each sample it was taken in different proportion and mixed with pre-weighed refined flour and corn flour according to the formulation table. The beaten butter with sugar powder was also incorporated along with milk powder and leavening agent. The dough was prepared and the dough preparation process are called kneading. The dough was kept for rest at room temperature for 30 minutes. The sheeting was formed and dough was rolled on a floured board by roller pin and the dough was moulded into circular shapes(25-30mm) with a cutter and arranged to a greased tray. The tray was placed in oven for baking, which was pre-heated. After baking at (160 °C for 15 min.) the trays were taken out from oven and cooled cookies was packed in LDPE at ambient temperature (30±4 °C).
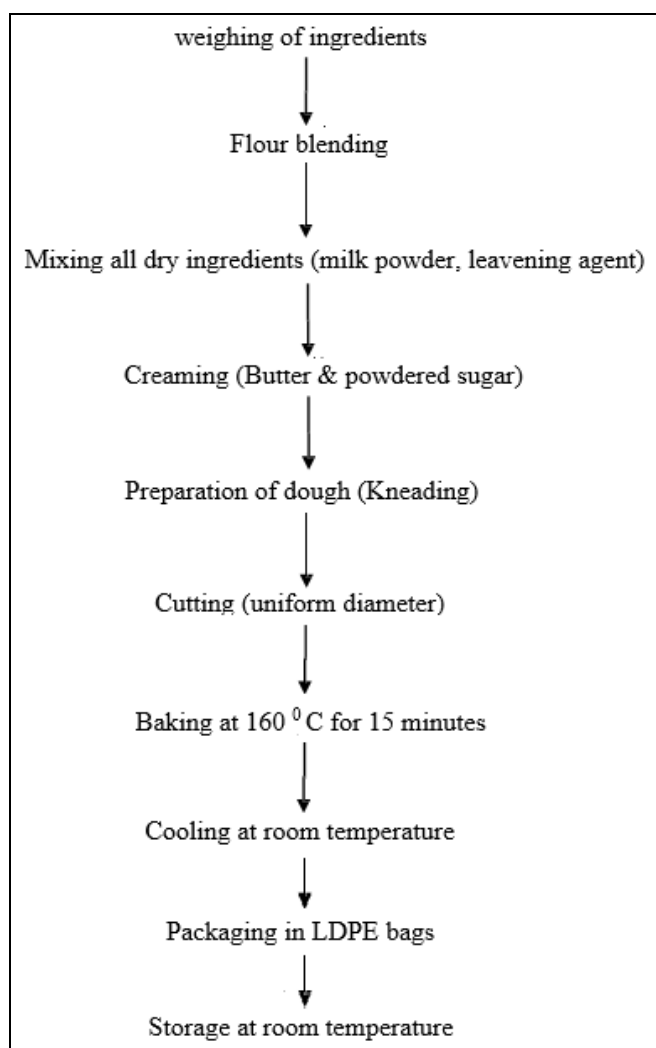
Fig 1: Flow chart for preparation of multigrain cookies

Chemical used

Bradford's Reagent, DNSA (Dinitro salicylic acid), Diethyl ether, Petroleum ether, Hexane Sulfuric acid, Sodium Hydroxide, Nutrient Agar, Agar-agar.

Sensory Analysis
Sensory evaluation of "multigrain cookies "was done by 9-point hedonic scale (Wichchukit *et al,* 2014) [8] and Adeyeye *et al.* (2014) [2] reported sensory evaluation results showed that the color, texture, taste and overall acceptability. Sensory attributes like colour, appearance, aroma, flavour, taste, texture and overall acceptability were evaluated by trained judges using 9-Point Hedonic Score System. The panellist gives score 9-1 to the product, ranging from 'like extremely' to 'disliked extremely' to find out the most suitable composition of cookies.

Statistical analysis
Statistical analysis of data was done by using ANOVA (Analysis of variance) two way with replication and critical differences was analysed by excel software. The significant differences were at 5% level.

Results and Discussion
Prepared multigrain cookies
Multigrain cookies were prepared from Refined wheat flour, corn flour and kodo millet flour as explained in Table.1. Seven treatments (T0, T1, T2, T3, T4, T5 and T6). The prepared multigrain cookies were prepared by the blending of flours in different ratio. In the preparation of cookies Refined -wheat flour ratio was substitute with blending of corn flour and kodo millet flour. Formulation of multigrain cookies was prepared in a specific proportion T0- RWF 100: CF 0: KF0, T1- RWF 80: CF 10: KF 10, T2- RWF 80: CF 15: KF 5, T4-RWF 60: CF20: KF:20, T5- RWF60:CF 30: KF 10, T6-RWF60: CF10: KF:30.

**Fig 2:** Formulated cookies sample T0, T1.T2, T3, T4, T5, T6

Table 2: Nutritional Content of the multigrain cookies

Treatments	Storage period	Moisture %	Ash %	Protein %	Reducing Sugar %	Fat %	Fiber %
T0	0 Day	4.18	0.92	11.86	89.85	20.30	0.83
	15 Days	4.21	0.91	11.84	89.84	20.29	0.82
	30 Days	4.29	0.88	11.81	89.84	20.28	0.81
	45 Days	4.32	0.85	11.79	89.80	20.26	0.77
T1	0 Day	4.16	0.98	12.14	89.34	20.70	0.89
	15 Days	4.19	0.96	12.10	89.33	20.68	0.87
	30 Days	4.23	0.92	12.08	89.30	20.68	0.85
	45 Days	4.29	0.88	12.00	89.28	20.65	0.83
T2	0 Day	4.09	1.09	12.36	88.87	21.19	0.91
	15 Days	4.13	1.07	12.32	88.86	21.15	0.90
	30 Days	4.20	1.07	12.28	88.82	21.12	0.88
	45 Days	4.24	0.97	12.24	88.79	21.07	0.86
T3	0 Day	4.01	1.17	12.99	88.21	21.65	1.12
	15 Days	4.11	1.15	12.96	88.19	21.63	1.11
	30 Days	4.19	1.14	12.91	88.16	21.60	1.09
	45 Days	4.23	1.12	12.88	88.13	21.58	1.02
T4	0 Days	3.91	1.28	13.10	88.90	21.42	1.23
	15 Days	4.00	1.26	13.08	88.60	21.40	1.21
	30 Days	4.10	1.26	13.04	87.92	21.35	1.19
	45 Days	4.15	1.21	12.99	87.88	21.35	1.16
T5	0 Day	3.88	1.41	13.21	87.82	22.13	1.39
	15 Days	3.96	1.38	13.17	87.60	22.11	1.37
	30 Days	4.05	1.38	13.13	86.71	22.09	1.35

	45 Days	4.10	1.33	13.10	86.68	22.00	1.34
T6	0 Day	3.56	1.49	13.41	85.79	22.32	1.61
	15 Days	3.60	1.46	13.38	85.77	22.30	1.60
	30 Day	3.79	1.44	13.35	85.74	22.27	1.58
	45 Days	3.96	1.41	13.32	85.73	22.26	1.54
Result		S	S	S	S	S	S
S.Ed.(±)		0.026	0.007	0.006	0.139	0.010	0.006
C.D.at 5%		0.054	0.015	0.014	0.293	0.020	0.012

Table.3: Sensory Evaluation of multigrain cookies

Treatments	Color	Appearance	Aroma	Flavour	Taste	Texture	Overall acceptability
T0	7.50	7.40	7.10	7.50	7.25	7.03	6.8
T1	6.00	6.90	6.28	6.28	6.95	6.63	6.7
T2	7.00	5.50	6.13	6.13	6.83	6.35	6.4
T3	6.80	6.10	6.43	6.43	7.08	5.35	6.5
T4	6.00	5.20	6.63	6.63	6.25	6.15	6.2
T5	6.20	4.80	6.68	6.68	5.50	7.34	6.1
T6	7.00	6.50	8.12	8.12	7.88	7.28	7.3
Results	S	S	S	S	S	S	S
S.Ed.(±)	0.224	0.169	0.318	0.326	0.149	0.266	0.110
C.D. at 5%	0.487	0.369	0.693	0.710	0.326	0.579	0.239
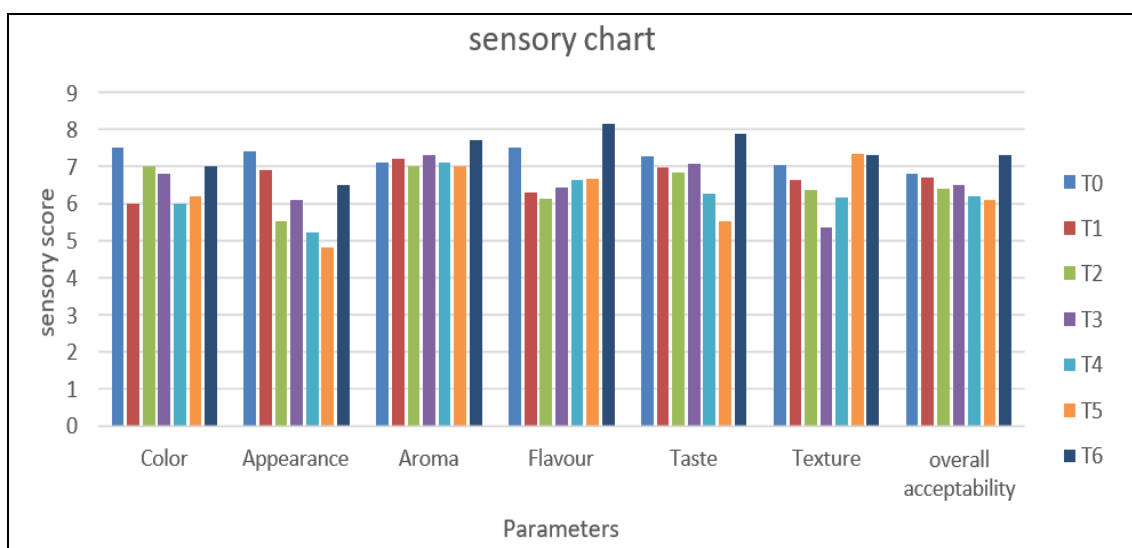
Fig 3: Sensory score (%) and overall acceptability of the product

The effect of storage period and different treatment effect of cookies presented in table.2. The moisture content of cookies was increased with increased storage period. Though LDPE has high permeation of air and water so, moisture content of cookies was increased in 45 days. In s research work higher amount of moisture was found in sample T0 due to higher amount of refined-wheat flour. Mitkal, *et al.,* (2021) [4], reported cookies absorbed moisture from surrounding due to hygroscopic behaviour of wheat flour. Sharoon, *et al.,* (2014) [7] reported increasing storage duration are responsible to the increment in moisture in cookies. In this research work maximum moisture content was found in sample T0 (4.18,4.21,4.29,4.32%) and minimum moisture content was (3.56, 3.60, 3.79, 3.96%). Moisture content of fresh cookies showed between 4.18 to 3.96%, which is lower than as compare to the moisture analysis result of Mitkal, *et al.,* (2021). Ash Content The result showed that ash content was slightly affected by the storage period of cookies. Maximum ash content was observed in sample T6 (1.49,1.46,1.46 and 1.41%) and minimum moisture content was found in sampleT0 (0.92,0.91,0.88 and 0.85%) during 45 days of

storage and this result showed the lower ash content as compare to Joel Ndife *et al.,* (2015) [6]. This research work shows the storage period was slightly reduces the ash content of cookies probably due to increment in moisture content probably. In this research work protein content was analysed for different sample of multigrain cookies. Higher protein content was found in sample T6 (13.41,13.38,13.35 and 13.32%) and lower protein content observed in sample T0 (11.86, 11.84,11.81 and 11.79%) and it was higher between 1-2% as compared to Mitkal *et al.,* (2021) [4]. Protein content of cookies was affected by the storage and packaging material. Reducing sugar content of different samples increases significantly which is due to increasing amount of refined-wheat flour and corn flour and storage was slightly affected the protein content of the cookies in LDPE. Refined -wheat flour and corn flour contain high amount of carbohydrate as compare to kodo millet flour. Sample T0 which contain 100% refined-wheat flour showed (89.85%) high amount of reducing sugar (as compare to sample T6, which showed (85.79%) least amount of reducing sugar and it was higher at 16% level as compared with Shiv *et al.,*(2010) and packaging

material also affected the reducing sugar content during 45 days of storage and affected amount percentage was observed between 1-2%. Fat content in prepared cookies was observed higher in fresh sample T6 (22.32%) and lower in T0 (20.30%). All flour contains high amount of fat content but kodo contain higher as compare to refined -wheat flour and fat content was almost similar as compare to Meena *et al.,* (2020). In cookies preparation, addition of fat developed tenderness makes it more palatable; helped in texture improvement reported by Mitkal *et al.,* (2021) [4]. External addition of fat during production of cookies have plasticizing effect reported by Mulvaney *et al.* (1997) [5]. Fibre content in sample T0 (100%) refined-wheat flour and this sample was control sample. In refined-wheat flour fibre are separated from wheat flour and separation of fiber makes them smooth texture as compare to wheat flour. Least amount of fibre found in sample T0 (0.83%) and higher amount was observed in sample T6 (1.54%) was low as compare to Mitkal *et al.,* (2021) [4] and the difference between the compared result was 2.5-3%. Protein content, reducing sugar, fiber and fat content was slightly affected by the LDPE packaging material and storage at ambient temperature was slightly reduced.

Conclusion

In this research work obtained result concluded that the multigrain cookies T6 (RWF 60: CF 10: KF 30) was most accepted on the basis of higher amount of protein content, fibre content and ash content and high score of overall acceptability. Sample T6 indicates the results of lower moisture content in cookies was 3.56, 3.60, 3.79, 3.96%, ash contain, 1.49, 1.46, 1.46 and 1.41, protein content 13.41, 13.38, 13.35, 13.32%, reducing sugar content 85.79, 85.77, 85.74, 85.73%, fat content 22.32, 22.30, 22.27, 22.26%, fibre content 1.61, 1.60, 1.58 and % was obtained at 0 day, 15 days, 30 days and 45 days respectively and overall acceptability of the product was 7.3%.

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