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## Development and nutrient analysis of sorghum (*Sorghum bicolor* L., Moench) cookies

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**Abstract**

Sorghum grown in *rabi* season has excellent grain quality with good quality protein, gluten free and rich in fiber. Bakery products especially cookies are cheapest snack items consumed by all class of people. Hence study was undertaken to develop the acceptable cookies from different sorghum varieties. Standardization of cookies showed 50 per cent of sorghum flour incorporation was highly acceptable. Among the four varieties KMJ-1 variety was highly suitable for preparation of cookies. Among different type of cookies, ground nut sorghum cookies was found highly acceptable. Significant differences in nutrient content of sorghum groundnut cookies were observed compared to control (RWF).

**Keywords:** sorghum, cookies, refined wheat flour, bakery products

**Introduction**

Sorghum is an important staple food for millions of people in the developing countries. It is also known as the great millet which has 5<sup>th</sup> rank in global production in cereals and is 4<sup>th</sup> after rice, wheat and maize in India. Sorghum grown in *rabi* season is characterized by excellent grain quality, exclusively used for human consumption. Sorghum grain contains non starchy polysaccharides and good protein quality with essential amino acid profile better than many of the cereals and millets. It is a rich source of fiber and B complex vitamin (Gopalan *et al.*, 2010 and Patil *et al.*, 2010) [2, 3]. 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 major items namely bread and biscuits account for almost 82 per cent of the total bakery products. Cookie” originates from a Dutch word *koekje*, which means “little cake;” the sound of a cracker being eaten most likely led to the use of that name (Zydenbos *et al.*, 2004) [4]. Cookies hold an important position in snack foods due to varieties in taste, crispiness and digestibility. At present cookies and biscuits are prepared from white flour which is inferior in quality and low in fiber content. Hence study was taken to develop nutritious sorghum cookies.

**Material and Methods**

The investigation was undertaken during 2016-17, Sorghum varieties, AKJ-1 (Atharga kempu jola), SMJ-1(Sakkari mukhari jola), KMJ-1 (Kagi moti jola) and M-35-1 (Bilijola) grown in farmers fields around Vijayapur and Regional Agricultural Research station, Vijayapur, University of Agricultural Sciences, Dharwad, Karnataka during *rabi* season were selected for investigation. The other raw materials were procured from Dharwad local market to prepare cookies.

Standardization of sorghum cookies were carried out by replacing refined wheat flour for sorghum flour at different level of incorporation in 100:0, 75:25, 50:50 and 25:75 (Refined wheat flour: sorghum flour) proportion. Refined wheat flour cookie was taken as control. Cookies were manually prepared by following traditional creamy method and baked in a commercial baking oven with top temperature of 180°C and bottom temperature of 150°C for 25 minutes. The highly acceptable cookie was further taken for varietal suitability study. The acceptable cookies analyzed for proximate and micronutrient (iron) contents by using standard methods.

The developed cookies were subjected to organoleptic evaluation on nine point Hedonic scale by 20 semi trained judges. The moisture, fat, protein, crude fibre and total minerals content of cookies were estimated by following the standard procedure (Anon., 2005) [5]. Total carbohydrate content was calculated by difference method. The trace minerals (iron and zinc) were estimated by using the Atomic Absorption Spectrophotometer. The calcium content of cookies was analyzed by titrimetric method.

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### Experimental results

Cookies developed from all selected sorghum varieties revealed significant differences between the varieties (Table 1). Among all the varieties, KMJ-1 highly acceptable appearance (7.56), colour (7.66), aroma (7.66) and overall acceptability (7.76). For the taste, AKJ-1 (7.56) was found high acceptable followed by KMJ-1 (7.70) and the M-35-1 (7.53). For overall acceptability, KMJ-1 cookies scored high (7.76) followed by AKJ-1 (7.64), M-35-1 (7.63), and SMJ-1 (7.36). No Significant difference was noticed between sorghum varieties for appearance, colour and overall acceptability. Acceptability Index for cookies showed that KMJ-1 was highly acceptable followed by AKJ-1, M-35-1 and SMJ-1 varieties. The KMJ-1 variety was highly acceptable for cookies preparation this could be due to the quality of grains suitable for popping that helped in spreading of cookies and also high moisture content of grains helps in high spread ratio (2.68 cm).

Different types of sorghum cookies were developed and evaluated for acceptability (Table 2). Sorghum ground nut cookies scored high for appearance (8.03) and spicy cookies low (7.36). The ground nut cookies (7.93) were highly acceptable for colour followed by butter cookies, spicy cookies and coconut cookies (7.40). Sensory scores of all four types of sorghum cookies for overall acceptability ranged from 7.33 to 8.10. Acceptability of cookies showed among all, ground nut cookies scored high (8.10) followed by butter cookies (7.70), coconut cookies (7.36) and spicy cookies (7.33) (Table 2). Significant difference was noticed for appearance, colour and overall acceptability among all four types of cookies. Among different types of sorghum cookies,

ground nut cookies (90.12) ranked first in acceptability index followed by butter cookies (81.48), coconut cookies (74.38) and spicy cookies (72.71).

The nutrient composition of sorghum ground nut cookies prepared (Table 3) indicated significant difference for all parameters except in carbohydrate content. The ash content was significantly high in ground nut cookies (1.64%) compared to control cookies (0.52%) these findings were similar with the result of Chavan *et al.*, (2016) [6]. The carbohydrate content was significantly high in control cookies than the sorghum cookies. The protein content was significantly high in ground nut cookies (11.03%) than control cookies (8.30%).

The ground nut cookies had high crude fiber (1.75%) than control cookies (0.23%) similar were made by Adeyeye, (2016) [1] and Chavan, *et al.* (2016) [6]. Significant difference was found for all parameters except for fat between the control (23.96) and ground nut cookies, (24.20 %). The highest energy content was found in refined wheat flour cookies (509 K cal) and lowest was found in groundnut cookies (498K cal), difference was statistically significant. The mineral content of sorghum ground nut cookies (Table 4) revealed high iron (7.07 mg) content compared to control (2.50 mg). Similarly high zinc content in sorghum ground nut cookies (1.70 mg) than control (0.30 mg).

Study revealed that KMJ-1 sorghum variety was best for preparation of cookies among the four varieties (M 35-1, SMJ-1 and AKJ-1). However sorghum cookies prepared from all the four varieties were acceptable for all sensory parameters. Sorghum groundnut cookies were rich in all nutrients compared to refined wheat flour cookies.

**Table 1:** Organoleptic evaluation of butter cookies prepared from different sorghum varieties

Sorghum varieties	Appearance	Colour	Taste	Aroma	Texture	Overall acceptability	Acceptability index
M-35-1	7.33 ± 0.38	7.36 ± 0.29	7.53 ± 0.65	7.43 ± 0.35	7.53 ± 0.59	7.63 ± 0.59	83.58
KMJ-1	7.56 ± 0.62	7.66 ± 0.47	7.70 ± 0.73	7.66 ± 0.58	7.53 ± 0.75	7.76 ± 0.77	85.37
SMJ-1	7.30 ± 0.74	7.30 ± 0.55	7.56 ± 0.75	7.50 ± 0.65	7.53 ± 0.70	7.36 ± 0.68	83.27
AKJ-1	7.43 ± 0.84	7.36 ± 0.65	7.76 ± 0.75	7.66 ± 0.84	7.86 ± 0.70	7.64 ± 0.66	84.81
S. Em. ±	0.3864	0.2880	0.4222	0.3582	0.4	0.3920	
C. D. @ 5 %	1.1083	0.8263	1.2112	1.0274	1.1472	1.1243	

**Table 2:** Organoleptic evaluation of different types of cookies prepared from KMJ-1 variety flour

Type of cookies	Appearance	Color	Taste	Aroma	Texture	Overall acceptability	Acceptability index
Ground nut	8.03 ± 0.67	7.93 ± 0.60	7.83 ± 0.67	7.53 ± 0.67	7.83 ± 0.50	8.10 ± 0.75	90.12
Coconut	7.48 ± 0.65	7.40 ± 0.54	7.40 ± 0.58	7.29 ± 0.55	7.70 ± 0.54	7.33 ± 0.67	74.38
Spicy	7.36 ± 0.50	7.06 ± 0.60	7.43 ± 0.60	7.50 ± 0.63	7.40 ± 0.69	7.33 ± 0.60	72.71
Butter	7.46 ± 0.18	6.93 ± 0.54	7.93 ± 0.14	7.20 ± 0.29	6.93 ± 0.36	7.53 ± 0.18	81.48
S.Em. ±	0.31273	0.3225	0.3182	0.3255	0.3095	0.3480	-
C. D. @ 5 %	0.8978	0.9261*	0.9137	0.9347	0.8887*	0.9992	-

\* Significant at 5% level

**Table 3:** Chemical composition of ground nut cookies from KMJ-1 variety (%)

Cookies	Moisture	Protein	Fat	Crude fiber	Ash	CHO	Energy (kcal)
RWF	2.28 ± 0.01	8.30 ± 0.56	23.96 ± 0.65	0.23 ± 0.06	0.52 ± 0.01	65.24 ± 0.64	509 ± 5.81
Ground nut cookies	2.21 ± 0.02	11.03 ± 0.88	24.20 ± 0.15	1.75 ± 0.21	1.64 ± 0.02	59.15 ± 0.73	498 ± 0.20
t-value	5.20*	4.53*	0.62 NS	11.70*	63.12**	10.83**	3.36*

\*\* Significant at 1% level

**Table 4:** Mineral content of KMJ-1 variety ground nut cookies (mg/100 g)

Varieties	Fe	Zn
Refined wheat flour (RWF)	2.50 ± 0.02	0.30 ± 0.01
Ground nut cookies	7.07 ± 0.02	1.70 ± 0.06
t- value	211.55**	39.352**

\*\* Significant at 1% level

**Table 5:** Dietary fiber content of ground nut cookies (%)

Type of cookies	Insoluble dietary fibre	Soluble dietary fibre	Total dietary fibre
RWF	2.96 ± 0.04	0.32 ± 0.01	3.42 ± 0.02
Ground nut cookies	6.33 ± 0.35	2.76 ± 0.05	9.10 ± 0.36
t- value	16.497*	72.323**	27.224*

\*\*significant @ 1%

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