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Development and quality evaluation of bagasse fibre mixed jaggery based cookies

S.I. ANWAR, KALYANI SHARMA, ADITYA LAL AND PRIYANKA SINGH

Cookies were made using whole wheat flour, bagasse and jaggery in the ratios of 100:0:25, 97:3:25, 98:2:30 and 97:3:30. It was found that water absorption and swelling power increased while bulk density, solubility index and dispersibility decreased with increase in bagasse quantity. Physical evaluation showed that there was no change in diameter and spread ratio of cookies. However, hardness and strength of cookies increased with increase in bagasse and jaggery quantity. The results of the chemical analysis showed that the moisture content of the cookies ranged between 4.81–7.57%, ash content 1.43–1.59%, crude fibre 1.53– 4.78%, protein content 11.04–13.99%, peroxide value 1.40–1.63 and carbohydrate 49.38–53.18%. Data obtained from the sensory evaluation indicated that the mean scores for appearance, taste, crispiness, colour, texture, flavour and overall acceptability were higher for cookies containing 97:3:30 ratio and highest mean scores for all the parameters assessed were significantly different ($p>0.05$) from the control (100:0:25). It may, therefore, be concluded that cookies prepared from the formulation comprising wheat flour, bagasse and jaggery in the ratio of 97:3:30 is the best and has a great commercial potential.

Key Words : Cookies, Bagasse, Jaggery, Fibre

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INTRODUCTION

Baked products are gaining popularity because of their availability, ready to eat convenience and reasonably good shelf-life. Cookies are the most commonly used bakery products in the world and are important food product used as snacks by children and adults.

Cookies hold an important position in snack food industry due to variety in taste, crispiness and digestibility. These are made in a variety of style using an array of ingredients including sugars, spices, chocolates, butter, peanut butter, nuts or dried fruits (Waheed *et al*., 2010). These are small flat, baked products usually containing fat, flour, egg and sugar and are mostly baked until crispy or just long enough that they remain soft. Cookies have a very low moisture content and good shelf-life and are taken by children, young people and adult to provide energy. These are made from dough, which is made from a mixture of flour and other ingredients, mixed together into dough, is rested for some time and passed between rollers to make a sheet. These are then cut into desired shape and size and are baked.

As human population continued to grow, there is a considerable worldwide interest in the utilization of wheat based food products. Wheat is the principal cereal widely used for making bread than any other cereal. It supplies

MEMBERS OF RESEARCH FORUM

Author for correspondence :
S.I. ANWAR, Jaggery Unit, ICAR-Indian Institute of Sugarcane Research, Raebareli Road, LUCKNOW (U.P.) INDIA
Email : sianwar@yahoo.co.in

Associate Authors' :
KALYANI SHARMA AND ADITYA LAL, Sam Higginbottom Institute of Agriculture, Technology and Sciences, ALLAHABAD (U.P.) INDIA

PRIYANKA SINGH, ICAR-Indian Institute of Sugarcane Research, Raebareli Road, LUCKNOW (U.P.) INDIA

about 20 per cent of the food calories for the world's people and is a national staple in many countries. It is the major ingredient in most breads, rolls, crackers, cookies, biscuits, cakes, doughnuts, macaroni, spaghetti, puddings, pizza, and many prepared hot and cold breakfast foods.The protein called gluten makes bread dough stick together and gives it the ability to retain gas. The whole wheat grain when ground with the skin and germ yields brownish flour called whole wheat flour. The same when refined further or ground without the skin yields whiter flour called refined flour or *Maida*. Whole wheat flour consists of the bran, germ and endosperm. On the other hand, *Maida* does yield attractive and mouthwatering results when used in any form of cooking but does not contain even quarter the amount of health benefits that whole wheat flour has to offer.The percentage of fibre content present in the whole wheat flour is comparatively higher than that present in *Maida*.

Sugar and jaggery (*gur*) are the main sweetening agents which are added to beverages and foods for increasing palatability. Jaggery is a natural and traditional sweetener made by the concentration of sugarcane juice or palm sap and is known all over the world in different local names (Thakur, 1999).

Sugarcane jaggery is a traditional unrefined non-centrifugal sugar consumed in Asia, Africa, Latin America and the Caribbean. Apart from being a sweetener, jaggery is a food material as well and is liked for its medicinal properties. It is cooling, diuretic, aperient, refreshing, improving throat conditions, normalizing semen and sperms, aphrodisiac, lactogenic and acts as cardiac tonic (Anwar *et al*., 2011). Jaggery provides energy for a longer time and is not harmful for the body. Apart from sucrose, it contains glucose and fructose, protein and minerals like calcium, iron, phosphorus etc. hence is more nutritious than sugar. Furthermore, jaggery is very good as a cleansing agent. It cleans lungs, stomach, intestines, oesophagus and respiratory tracts. Those who face dust in their day to day life are highly recommended to take a daily dose of jaggery. This can keep them safe from asthma, cough and cold, congestion in chest etc. (Nath *et al*., 2015).

Role and beneficial effect of fibre in human diet is well known. According to Dhingra *et al.* (2012), the diets with a high content of fibre, such as those rich in cereals, fruits and vegetables, have a positive effect on health since their consumption has been related to a decreased incidence of several types of diseases. Sugarcane bagasse contains high percentage of dietary fibre with numerous health benefits thus can effectively be used in food products. According to Leang and Saw (2011) the percentage of crude fibre content in bagasse is 30.4.

Present study aims at development of whole wheat flour cookies using jaggery as sweetening agent and sugarcane bagasse as supplementary fibre source and its quality evaluation.

METHODOLOGY

The work was conducted in the Processing Lab of Jaggery Unit at ICAR-Indian Institute of Sugarcane Research, Lucknow.

Raw materials :

Wheat flour (*Aashirvaad* whole wheat flour), shortening (*Amul* butter), baking powder (Sodium bicarbonate), sugarcane jaggery (*gur*) were used for product formulation. Sugarcane bagasse was obtained from crushing of sugarcane in a 3-roller crusher. The soft core part (pith) was taken out manually and was sun dried for two days. It was then made into powder form using a grinder.

Preparation of bagasse fibre mixed jaggery based cookies :

The bagasse powder, prepared earlier, was incorporated @ 2% and 3 % in the standardized recipe of cookies (Anonymous, 2000) with slight modifications. For this, bagasse powder and baking powder were mixed with wheat flour and sieved twice for uniform mixing. Butter was taken in a clean glass bowl and whipped thoroughly with the help of hand blender upto a cream like texture. To this, jaggery was mixed and whipped again to a smooth consistency. Then the composite flour, having different proportions of wheat flour and bagasse, was slowly added to the butter-jaggery mixture prepared earlier. The milk was later added as per the requirement to form soft dough.

The dough was kneaded into uniform thickness and cut into circular shape of diameter 6 cm and were placed in greased tray. The tray was kept in an oven (OTG) for 25 minute at a temperature of 100°C. The cookies were taken out and were kept for cooling to ambient temperature. The basic formulation of bagasse fibre mixed jaggery based cookies is given in Table A.

Table A : Basic formulation of bagasse fibre mixed jaggery based cookies

Ingredients (g)	T_0	T_1	T_2	T_3
Wheat flour	100	97	98	97
Bagasse	0	3	2	3
Jaggery	25	25	30	30
Butter	45	45	45	45
Sodium bicarbonate	1.2	1.2	1.2	1.2

Physico-chemical analyses of the composite flour and the prepared cookies :

Functional properties of the composite flour :

Water absorption capacity, swelling power, bulk density, solubility index and dispersibility of the composite flour were determined according to the methods described by Adeleke and Odedeji (2010).

Physical analysis of cookies :

Cookies diameter and the thickness were determined using vernier calipers. Spread ratio was expressed as diameter to thickness ratio. Volume and density were determined using basic calculations (Mc Watters *et al*., 2003). The colour values like L*, a* and b* values were determined using a colour reader (CR 10). The hue angle, chroma and browning index were determined using following equations:

$$\text{Hue angle (h)} = \tan^{-1}\left(\frac{b^*}{a^*}\right) \quad (1)$$

$$\text{Chroma} = \sqrt{a^{*2} + b^{*2}} \quad (2)$$

$$\text{Browning index} = \frac{[100\,(x - 0.31)]}{0.17} \quad (3)$$

where, $$x = \frac{(a^* + 1.75\,L^*)}{(5.645\,L^* + a^* - 3.012b^*)} \quad (4)$$

(Ruangchakpet and Sajjaanantakul, 2007)

Instrumental texture was evaluated using the TVT-300XP texture analyzer (Stable Micro System). The three point bend test was performed using an adjustable bridge (R-TPBR) with support 45 mm apart and a rounded end (P-BP70A) knife probe.

Chemical analysis of cookies :

All the determinations were done using Anonymous (1990) standard methods. Moisture content was determined using gravimetric method; ash by dry Ashing method (Method 900.02);crude fibre by acid hydrolysis (Method 962.09); fat content by Soxlet extraction method (Method 960.39); protein by micro Kjeldahl method (Method 981.10) while carbohydrates were determined by difference method.

The energy content of cookies was calculated by factorial method (FAO, 2003) on dry basis using following formula:

Energy (kj) = [4.0 x protein (g) + 4.0 x carbohydrates (g) + 9.0 x fat ((g)] x 4.19 (5)

Organoleptic evaluation :

Organoleptic characteristics of bagasse fibre mixed jaggery based cookies were evaluated by 19 trained panelists using 9-point hedonic scale with corresponding descriptive terms ranging from 9 'like extremely' to 1 'dislike extremely'.The data were analyzed to compare sensory rating of the samples.

Statistical analysis :

The experiments were conducted by adopting Completely Randomized Design. The data recorded during the course of investigation were statistically analyzed by the analysis of variance (ANOVA) described by Steel *et al.* (1997). The significant effect of treatment was judged with the help of F-test (variance ratio). Calculated 'F' value was compared with the tabulated 'F' value. If calculated value exceeded the tabulated value, the effect was considered to be significant. Standard error and critical difference were also calculated on the basis of anova table.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Functional properties of wheat flour blended with bagasse :

Functional properties like water absorption, swelling power, bulk density, solubility index and dispersibility of different flour samples have been given in Table 1.

The water absorption increased with increase in bagasse quantity. The wheat flour blends of 97:3 had more water absorption as compared to blends of 98:2 and 100:0. The Swelling power of flour samples increased with increase in temperature and 100% wheat flour showed maximum swelling power at 100^0 C as compared to different blends at all the working temperatures. However, swelling power decreased with increase in bagasse content. The bulk density also decreased with increase in bagasse content. This is due to lower bulk density of bagasse as compared to wheat flour. The solubility drastically changed when bagasse was mixed with wheat flour, this was mainly due to insoluble nature of bagasse. The dispersibility was also reduced when bagasse was mixed with wheat flour, which may be due to the non-dispersive nature of bagasse.

Physical properties of cookies :

Table 2 clearly indicated that use of bagasse and jaggery did not produce any significant effect on diameter, thickness, spread ratio, volume and density of cookies. However, maximum hardness (15.47 N) was observed in T_3 and minimum in T_0 (6.86 N). Similar trend was observed in strength with maximum strength (0.35 N/mm) was found in T_3 and minimum in T_0. These effects were clearly due to addition of bagasse and jaggery in samples T_1, T_2 and T_3.

Effect of Bagasse and Jaggery on colour values of cookies :

The L*, a* and b* values of colour are presented in the Table 3. It was observed that the L* values have significant difference among all the treatments. The maximum L* value was observed in T_1 (55.67) and

Table 1 : Functional properties of wheat flour blended with bagasse

Treatments	Water absorption (%)	Swelling power					Bulk density (kg/m^3)	Solubility index (%)	Dispersibility (%)
		60°	70°	80°	90°	100°			
100% WF	2.97	8.61	8.7	8.73	9.37	11.46	753	9.07	31.33
98% WF and 2% B	3.28	7.52	7.81	8.65	8.97	10.87	687	7.74	30.67
97% WF and 3% B	4.53	6.73	7.06	7.39	8.37	9.87	563	7.27	30.33
F-Test	S	NS	NS	S	NS	NS	NS	S	NS
C.D. (P=0.05)	1.27	-	-	0.527	-	-	-	1.214	-
S.E (mean)	0.35	0.48	0.74	0.149	0.36	0.75	0.04	0.34	0.33

S = Statistically significant NS = Statistically non-significant

Table 2 : Physical properties of cookies

Treatments	Diameter (cm)	Thickness (cm)	Spread ratio	Volume (cc)	Density (g/cc)	Hardness (N)	Strength (N/mm)
T_0	5.77	0.45	12.68	11.79	1.09	6.86	0.17
T_1	5.82	0.47	14.68	10.97	1.17	10.67	0.27
T_2	5.93	0.45	13.18	12.18	1.11	10.87	0.24
T_3	5.88	0.40	14.74	10.57	1.59	15.47	0.35
F-Test	NS	NS	NS	NS	NS	S	S
C.D. (P=0.05)	-	-	-	-	-	4.405	0.107
S.E (mean)	0.053	0.019	0.556	0.618	0.130	4.337	0.105

S = Statistically significant NS = Statistically non-significant

Table 3 : Effect of bagasse and jaggery on colour values of cookies

Treatments	L* Values	a* Values	b* Values	Hue Angle (°)	Chroma	Browning index
T_0	53.87	12.97	30.80	67.17	33.47	98.97
T_1	55.67	12.57	30.70	67.73	33.17	93.79
T_2	50.37	13.87	30.57	65.59	33.56	108.76
T_3	52.20	14.20	31.53	65.75	34.58	107.99
F-Test	S	S	NS	S	S	S
C.D. (P=0.05)	1.418	0.662	-	1.177	0.709	1.575
S.E (mean)	0.428	0.200	0.221	0.355	0.214	0.447

S = Statistically significant NS = Statistically non-significant

minimum in T_2 (50.37). The L* values of T_0 and T_1 were significantly higher than T_2 and T_3 and this may be due to the lesser percentage of jaggery (30%) used in the formulation. The a* value was significantly higher in T_2 (13.87) and T_3 (14.20) than a* values of T_0 (12.97) and T_1 (12.57). These were higher because of the higher amount of jaggery used in T_2 and T_3 as compared to T_1 and T_0. There was no significant difference in b* values of all the treatments. However, maximum b* value was observed in T_3 (31.53). Significantly higher values of hue angle were observed in T_0 and T_1. This might be due to presence of lesser amount of jaggery as compared to T_2 and T_3. Significantly higher value of Chroma was observed in T_3 (34.58). However, Chroma values of T_0, T_1 and T_2 were found statistically at par. The browning index of T_2 and T_3 are significantly at par but comparatively higher than T_0 and T_1. Higher values in T_2 and T_3 are due to presence of jaggery in higher quantity.

Chemical properties of cookies :

The data presented in Table 4 showed that there was no significant difference found for ash, fat, protein, peroxide value, carbohydrate, pH and energy values of different samples of cookies. However, the values of moisture and crude fibre showed significant difference. Cookies prepared from 100% wheat flour has more moisture retention than cookies with bagasse. There was significant difference in crude fibre content in cookies. Sample T_1 and T_3 contained higher values of crude fibre (4.47% and 4.78%, respectively) as compared to T_0 (1.53%) and T_2 (3.47%). This clearly indicates the effect of bagasse in the formulation. Close values in case of T_1 and T_3 were due to the fact that equal quantity of bagasse (3%) was used in these two formulations and minimum value in case of T_0 as no bagasse was used.

Organoleptic evaluation of cookies (On Nine-point

Table 4 : Chemical properties of cookies

Treatments	Moisture (%) (w.b)	Ash (%)	Crude fibre (%)	Fat (%)	Protein (%)	Peroxide value (mEq/kg of peroxide)	Carbohydrate (%)	pH	Energy (kJ/100 g)
T_0	7.57	1.43	1.53	32.46	11.47	1.48	53.18	5.87	2306.66
T_1	4.81	1.47	4.47	32.67	11.59	1.63	49.74	5.77	2246.22
T_2	5.64	1.57	3.47	32.63	13.99	1.57	49.57	5.57	2294.78
T_3	5.37	1.59	4.78	33.28	11.04	1.40	49.38	5.57	2267.86
F-Test	S	NS	S	NS	NS	NS	NS	NS	NS
C.D. (P=0.05)	1.780	-	0.396	-	-	-	-	-	-
S.E. (mean)	0.537	0.056	0.119	0.970	1.123	0.178	1.545	0.159	24.005

S = Statistically significant NS = Statistically non-significant

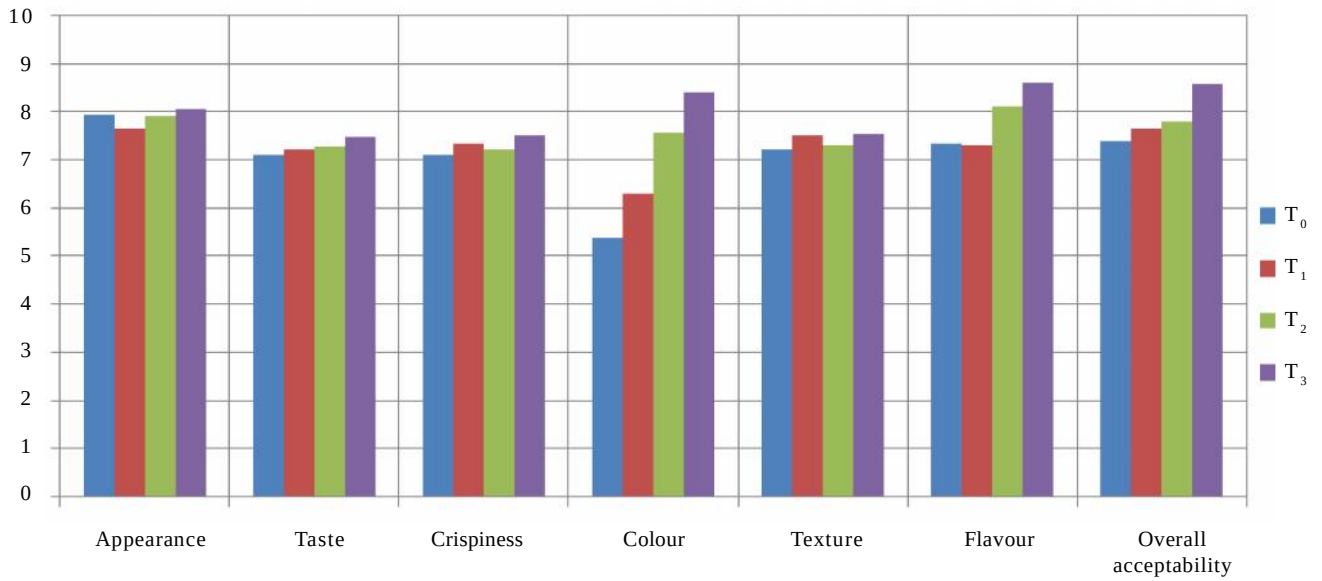

Fig. 1 : Organoleptic properties of cookies (on Nine-Point Hedonic Scale)

Hedonic scale) :

Fig. 1 clearly indicated significant difference in the sensory parameter of all the treatments. The cookies prepared with ratio 97:3:30 (T_3) had the highest level of score with 7.84 on a nine point hedonic scale for over all acceptability. The sample had a brown colour and this increased the appeal of the product and found to be significant having higher value of T_3(8.47). Data indicated that the per cent score of cookies containing 97:3:30 (T_3) were found to be the most acceptable. The colour scores of cookies with T_3 reached maximum than to the rest of the proportions. Data also indicated that the per cent score of cookies containing 97:3:30 (T_3) were found to be the most significant having higher value for flavour (8.67). Thus, incorporation of bagasse and jaggery at different level improved the sensory attributes namely appearance, taste, crispiness, colour, texture, flavour and overall acceptability. This is in tune with the findings of Goyle and Gujral (1992) who reported that the nutritional qualities of the cookies were enhanced due to iron and fibre enrichment.

Conclusion :

This work showed the nutritional, physico-chemical and sensory characteristics of bagasse fibre mixed jaggery based cookies. Among four treatments *i.e.* (T_0, T_1, T_2 and T_3), T_3 sample was found to be the best depending upon different sensory attributes like colour, taste, flavour, texture and overall acceptability. This was so because the values for all the sensory attribute was maximum for sample T_3 as compared to other treatments. The incorporation of different levels of bagasse in whole wheat flour as well as jaggery in cookies significantly affected the chemical composition of the developed cookies in positive ways. There was significant increase in ash, moisture, carbohydrate, fibre and peroxide content with increasing levels of bagasse and jaggery. It can be concluded that fibre rich jaggery based cookies may be successfully prepared taking sugarcane bagasse (@ 2% and 3%) as a supplementary fibre source and jaggery (25 g and 30 g/100 g bagasse blended wheat flour) as a sweetening agent. These cookies would be useful for children and families of all economic standings, as a wholesome and inexpensive snack food which is the best way to incorporate fibre in a diet. The results obtained could be very valuable in decision making for industries that want to take nutritional advantage of bagasse as alternative or supplement to fibre and jaggery as an alternative to sugar. Jaggery and bagasse, both the product of jaggery industry, could be used in the manufacture of highly nutritious and fibrous biscuits/cookies. With this, a subsidiary industry could be developed at small scale/ cottage level generating rural employment.

LITERATURE CITED

Adeleke, R. and Odedeji, J. (2010). Functional Properties of Wheat and Sweet Potato Flour Blends. *Pak. J. Nutri.*, **9** : 535-538.

Anonymous (1990). Official Methods of Analysis. Washington DC: Association of Official Analytical Chemistry (AOAC).

Anonymous (2000). Approved Method of the AACC.10th ed., American Association of Cereal Chemists, INC. St., Paul, Minnesota, USA.

Anonymous (2003). Food energy- methods of analysis and conversion factors. Report of a technical workshop. FAO Food and Nutrition Paper No. 77, Rome.

Anwar, S.I., Singh, R.D. and Singh J. (2011). Process development for production of jaggery (gur) with aonla as a natural source of vitamin C. *J. Institution of Engineers* (India), **92**(1):33-35.

Dhingra, D., Michael, M., Rajput, H. and Patil, R.J. (2012). Dietary fibre in foods:a review *J. Food Sci. Technol.*, **49** (3) : 255-266.

FAO (2003). Market research for agroprocessors, by A. W. Shepherd, Marketing Extension Guide No. 3, Rome, Italy.

Goyle, A. and Gujral, S. (1992). Sensory evolution and acceptability trials on biscuits prepared from raw and milled wheat-Bengal gram mixes with or without a green leafy vegetable. *Plants Foods Human Nutri.*, **42**:291-296.

Leang, Y.H. and Saw, H.Y. (2011). Proximate and functional properties of sugarcane bagasse. *Agro Food Industry Hi-tech.*, **22**(2) : 5-8.

McWatters, K.H., Ouedraogo, J.B., Resurrection, A.V.A. and Hung Phillips, Y.R.D. (2003). Physical and sensory characteristics of sugar cookies containing mixtures of wheat, fonio (*Digitaria exilis*) and cowpea (*Vigna unguiculata*) flours. *Internat. J. Food Sci. Technol.*, **38** : 403-410.

Nath, A., Dutta, D., Kumar, P. and Singh J.P. (2015). Review on recent advances in value addition of jaggery based products. *J. Food Process Technol*., **6** : 440.

Ruangchakpet, A. and Sajjaanantakul, T. (2007). Effect of browning on total phenolic, flavonoid content and

antioxidant activity in Indian Gooseberry (*Phyllanthus emblica* Linn.). *Kasetart J. (Natural Science)*, **41**:331-337.

Steel, R.G.D., Torrie, J.H. and Dickey, D.A. (1997). Principles and procedures of statistics. A Biometrical Approach. 3rd Ed. McGraw Hill Book Co. Inc. New York, U.S.A.

Thakur, A.K. (1999). Potential of jaggery (Gur) manufacturing in Punjab state. *Proc National Seminar on Status, Problems and Prospects of Jaggery and Khandsari Industry in India*, Indian Institute of Sugarcane Research.Lucknow, India.

Waheed, A., Rasool, G. and Asghar, A. (2010). Effect of interesterified palm and cottonseed oil blends on cookie quality. *Agric. Biol. J. N. Am.*, **1**(3) : 402-406.

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