International Journal of Advanced Biotechnology and Research(IJBR)
ISSN 0976-2612, Online ISSN 2278–599X,
Vol5, Issue3, 2014, pp381-387
http://www.bipublication.com

Formulation of Buckwheat Cookies and their Nutritional, Physical, Sensory and Microbiological Analysis

Nidhi Chopra[1], Bhavnita Dhillon[2] and Shruti Puri[3]

[1,2,3] Guru Nanak Dev University, Amritsar 143005, Panjab, India.
[*] Corresponding Author: E-mail: bhavnita.dhillon@msn.com Tel: +91- 9465865000

[Received-22/05/2014, Accepted-12/07/2014]

ABSTRACT

The consumer demand is increasing for composite flour based bakery products like cookies and biscuits. The incorporation of buckwheat flour into wheat flour can prove to be essential in composite flour based cookies. It has beneficial nutraceutical properties and its gluten- free nature can play important role in preventing celiac problem. The physicochemical properties of buckwheat flour and wheat flour were studied and cookies were prepared with the incorporation of buckwheat flour in 100, 50, 75 % concentration with wheat flour to measure the quality and acceptability of cookies. As the concentration of buckwheat flour was increased, spread ratio of cookies decreased. With the increase in the level of buckwheat flour in the formulation, the sensory scores for texture, appearance, flavour of cookies decreased. The score of flavour reduced significantly to 5.71 at higher concentration, possibly due to presence of flavonoids compound (rutin) having bitter taste on buckwheat flour. The cookies formed with addition of 75% buckwheat and 100% Wheat got high overall acceptability score respectively.

Keywords: Buckwheat flour, supplemented cookies, physicochemical properties, sensory analysis

[I] INTRODUCTION

Nowadays development of fortified cookies or other composite flour bakery products is the latest trend in bakery industry. Among ready to eat snacks, cookies possess several attractive feature including wider consumption base, relatively long shelf life, more convenience and good eating quality [1, 2]. Long shelf life of cookies makes large scale production and distribution possible. Good eating quality makes cookies attractive for protein fortification and other nutritional improvements. The growing interest in these types of bakery products is due to their nutritional properties and possibility of their use in feeding programs and in catastrophic situations such as starvation of earthquakes [3].

Buckwheat (*Fagopyrum esculentum*) is a psuedocereal growing in simple conditions and can prove as an imminent and forthcoming nutritional source for the “Starving World” [4]. Among various varieties of buckwheat, two buckwheat species are commonly cultivated: Common buckwheat or sweet buckwheat (*Fagopyrum esculentum Moench*) and Tartary buckwheat (*Fagopyrum tartaricum*) [5]. It is

called as “kuttu” in Hindi and is a traditional underutilized crop plant belonging to family *Polygonaceae* [6]. The structure and characteristics of buckwheat grain are quite different from those of wheat grain. Buckwheat grains contain numerous nutraceutical compounds [7] and they are rich in vitamins, especially those of B group [8]. It has higher lysine, iron, copper and magnesium content than wheat flour [9]. The significant contents of rutin, catechins and other polyphenols as well as their potential antioxidants activity are also of great significance [10, 11]. These functional components of buckwheat have health benefits like reducing high blood pressure, lowering cholesterol, controlling blood sugar and preventing cancer risk [8, 12].

Buckwheat flour may be used in the manufacture of bread, cookies, pies, pancakes, the macroni products etc. [13]. The incorporation of buckwheat flour can be justified in composite flour based cookies as it has beneficial nutraceutical properties and its gluten free nature can play important role in preventing celiac problem. Cereal grains, including soft wheat are low in protein (7 to 14%) and deficient in some amino acids such as lysine. Buckwheat on the other hand, has higher protein quality than other cereal grains and could be used to support certain amino acids such as lysine, histidine, valine, leucine. Keeping in view the nutraceutical and other physical properties of buckwheat, the present study was undertaken with the objectives to compare the composition of buckwheat flour with wheat flour and formulation of wheat flour with buckwheat flour at different concentrations to prepare cookies and assess its quality and acceptability.

[II] MATERIALS AND METHODS

2.1. Materials

Buckwheat flour was purchased from local market (Moga, Punjab). Wheat flour of Ashirwad brand made from ITC was obtained from local market of Amritsar. All the ingredients required for cookie making were also bought from local market Amritsar.

2.2. Product development

The cookies were prepared by modifying method of AACC (10-50-D) [14]. The cookies were prepared with the incorporation of buckwheat flour (BWF) in 100, 50, 75% concentration with wheat flour(WF) keeping sugar and fat amount constant to 55 and 42gm respectively on 100gm flour basis. Ground sugar, margarine (low cholestrol Amul butter), shortening were creamed together in a Hobart mixer (Model N50, Canada) having flat beater blades for 6 min at 60rpm. The buckwheat flour, wheat flour in required amount and 1.14gm sodium bicarbonate, vanilla essence, 25gm egg albumin were added to the creamed mixture and mixed for 8 min at medium speed to obtain a homogenous mixture. The kneaded dough was sheeted to a thickness 7mm using cookie table. The cookies were cut with cookies die to desired diameter and transferred to a lightly greased aluminium baking tray. The cookies were baked at 200 °C for 12 min in a baking oven. The baked biscuit were cooled for 1-2 min and stored in an air tight container for further analysis. Eight different types of cookies were prepared at various concentrations, four containing egg as binder and rest containing xanthan gum. In xanthan gum cookies, water (10 ml) is used for the mixing of dough. The xanthan gum was pre soaked for 10 min in water (1: 10). There is no need of water in case of cookies with egg due to the egg albumin.

2.3. Compositional Studies

Protein (Kjeldahl, N× 6.25), fat (solvent extraction), moisture, ash and crude fibre of buckwheat flour, wheat flour and formulated cookies were determined by AOAC (2000) methods [15]. The carbohydrate content was calculated by subtraction method AOAC (1980) [16].

2.4. Microbiological evaluation

Total Plate Count (TPC) and Yeast and Mould Count

(YMC) were performed for buckwheat cookies as well as buckwheat and wheat flour. It was determined by using serial dilution pour plate method. The number of colonies appearing on dilution plates were counted, averaged and reported as cells per gram (cfu/gm) of the sample.

2.5. Physical analysis of cookies

Diameter of cookies was measured by laying six cookies edge to edge with the help of a scale rotating those 90° and again measuring the diameter of six cookies (cm) and then taking average value. Thickness was measured by stacking six cookies on top of each other and taking average thickness (cm). Spread ratio was calculated by dividing the average value of diameter by average value of thickness of cookies.

2.6. Sensory evaluation

Sensory evaluation consisted of judging the quality of prepared cookies by a panel of judges. A hedonic rating test was used to measure on a scale of 9 points from "like extremely" to "dislike extremely".

2.7. Statistical Evaluation

The results were evaluated by using analysis of variance (ANOVA) of Statistical software SAS 9.1 (SAS Inst. Inc., Car, N.C., U.S.A.) at 95% level of confidence. The statistical significance of difference between mean of treatments was determined by Duncan's multiple range test.

[III] RESULTS AND DISCUSSION

3.1. Proximate composition of flours

The proximate compositions of buckwheat and wheat flour are given in Table 1. It shows that fat content of buckwheat and wheat flour did not significantly. However a significant difference was observed in ash, crude fibre, protein, moisture and carbohydrate content of buckwheat and wheat flour. Buckwheat flour showed higher protein content (12.82%) and higher crude fibre content (0.65%) in comparison to wheat flour. Buckwheat flour contains 8.5% to near 19% of proteins depending on the variety, pesticide used, and fertilization that are likely to affect the total concentration of buckwheat proteins [13].

3.2. Proximate composition of cookies

The proximate composition of cookies is shown in Table 2. The ash content of cookies increased with the addition of buckwheat flour up to 75% concentration. The moisture content of buckwheat cookies with egg ranged from 15.53 to 18.46% but in cookies with xanthan gum it ranged from 15.26 (db) to 15.70% (db). Moisture content of cookies with egg was comparable to cookies with xanthan gum. Xanthan gum has the tendency to absorb water. An increase in moisture content due to increase in protein content and decrease in moisture content due to decrease in protein content was reported by [18]. The fat content of cookies with egg ranged from 15.6 to 16.8% (db), cookies with xanthan gum ranged from 15.1 to 16.5% (db). The fat content was increased probably due to oil retention ability of buckwheat flour during baking process [19]. Higher oil retention improves the mouth feel and retains the flavor of cookies. No definite trend in increase or decrease in crude fibre contents was observed. The protein content of cookies with egg ranged from 11.4 to 17.4%, cookies with xanthan gum ranged from 9.83 to 15.8%. The protein content of cookies with egg increased due to the addition of egg albumin, egg albumin contains 11% protein. Earlier, in literature it was reported that cookies showed decrease in protein content when buckwheat flour concentration was increased. The carbohydrate content as determined by difference method was found to be higher in 100% wheat flour with xanthan gum cookies.

3.3. Microbiological evaluation

In buckwheat flour, bacterial and YMC occurred to a large extent, this may be due to the fact that buckwheat flour was not processed. On the other hand, wheat flour did not show microbial growth as it was processed. No microbial growth (YMC and bacterial growth) was observed in the analysis of buckwheat flour cookies as it was

processed at high temperature at 200 °C/ 12 min. Some customers have set the limits for APC and YMC in buckwheat to be 5.5- and 4.7- log10 colony forming unit (CFU)/g and sufficient reduction of microbes could be achieved at a lower concentration of ACS, thereby reducing the effect on colour [20].

3.4. Physical characteristics of cookies

The physical properties of cookies prepared from BWF and WF were determined. The diameter of cookies made of concentration 100BW+E, 100W+E, 50BW+50W+E were found significantly lower than that of 75BW+25W+E. The thickness of cookies ranged from 4.4 to 4.9 cm. It increased with the incorporation of buckwheat flour. Increase in thickness may be due to the decrease in diameter. The changes in diameter and thickness were reflected in spread ratio of cookies. The spread ratio increased with the addition of buckwheat flour. It was reported that the spread ratio decreased with addition of buckwheat flour [5]. Reduced spread ratios of cookies were attributed to the fact that composite flours apparently form aggregates with increased numbers of hydrophilic sites available that compete for the limited free water in cookies dough [21].

3.5. Sensory characteristics of cookies

Fig 2 depicts the effect of buckwheat flour incorporation on the sensory characteristics of cookies. With the increase in the level of buckwheat flour in the formulation, the sensory scores for texture, appearance, flavor of cookies decreased. The score of appearance decreased with the addition of buckwheat flour because it had lower lightness and higher yellowness. Top grain, appearance and texture score increased to 8.75 at 100% concentration of Wheat flour. Score of Wheat cookies was greater than Buckwheat cookies. Top grain, appearance, texture and flavor score reduced to 5.25 at 100% concentration of buckwheat flour. This was because of cracks formed with the addition of gluten free buckwheat flour. The score of flavor reduced significantly to 5.71 at higher concentration, possibly due to presence of flavonoids compound (rutin) having bitter taste on buckwheat flour. The cookies formed with addition of 75% buckwheat and 100% wheat got high overall acceptability score respectively.

[IV] CONCLUSION

Buckwheat flour addition into cookies had considerable effect on physiochemical and sensory properties of cookies. It may be concluded from the study that buckwheat flour can be successfully incorporated in wheat flour up to a level of 75% to yield cookies of enhanced nutritional quality with acceptable sensory attributes. Hence, development and utilization of such functional foods will not only improve the nutritional status of the population but also help those suffering from degenerative diseases. More studies should be conducted to investigate the possibility of using buckwheat flour as an ingredient in other food products in order to increase application of such value added food product.

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Tables and Figures:

[Table- I]

Parameter	Buckwheat flour	wheat flour
Moisture(%)	10.91 ± 0.02	13.18 ± 0.01
Ash(%)	1.38 ± 0.01	1.26 ± 0.02
Crude fibre(%)	1.75 ± 0.02	1.73 ± 0.02
Fat(%)	12.82 ± 0.01	10.65 ± 0.01
Protein(%)	0.65 ± 0.01	0.58 ± 0.02

Table 1. Proximate composition of flours. All readings were taken in triplicates at ($P<0.05$)

[Table – II]

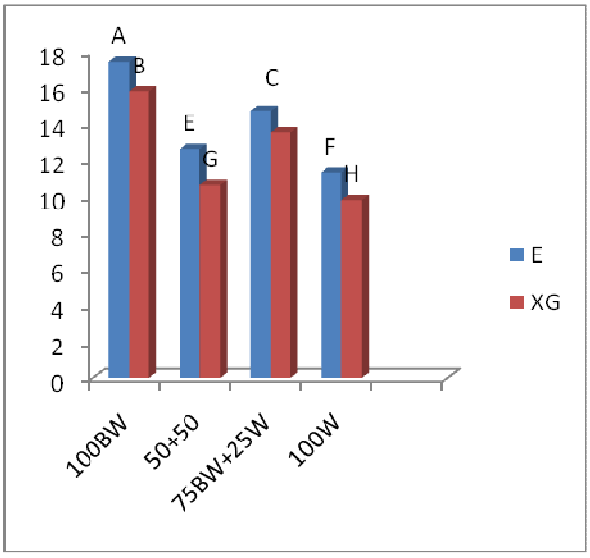
Sample No	Moisture(%)	Fat(%)	Protein(%)	Fibre(%)	Ash (%)	Carbohydrate(%)
100BW+E	15.53 ± 0.4^{BC}	16.8 ± 0.2^{A}	17.4 ± 0.1^{A}	0.63 ± 0.5^{A}	1.46 ± 0.1^{CB}	48.18 ± 0.1^{G}
100W+E	18.46 ± 0.2^{A}	16.4 ± 0.4^{AB}	11.4 ± 0.1^{F}	0.53 ± 0.6^{AB}	1.38 ± 0.2^{CB}	52.13 ± 0.2^{E}
50BW+50W+E	16.50 ± 0.1^{B}	16.3 ± 0.2^{AB}	12.8 ± 0.1^{E}	0.43 ± 0.5^{B}	1.48 ± 0.5^{ABC}	52.49 ± 0.1^{D}
75BW+25W+E	15.76 ± 0.1^{BC}	15.6 ± 0.7^{CD}	14.5 ± 0.2^{C}	0.56 ± 0.5^{AB}	1.64 ± 0.2^{AB}	51.94 ± 0.1^{C}

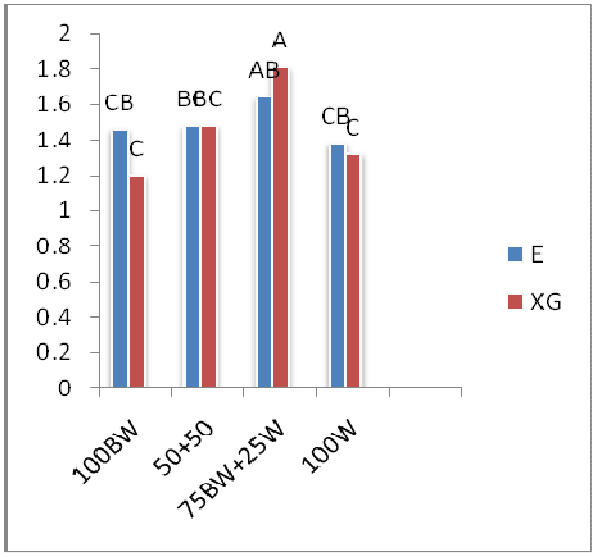
All readings were taken in triplicates at ($P<0.05$)
Means followed by same superscripts in rows do not differ significantly
BW+E= Buckwheat flour + egg albumin, W+E= Wheat flour + egg
Table 2: Proximate composition of buckwheat cookies with egg

[Table- III]

Sample no	Moisture(%)	Fat(%)	Protein(%)	Fibre(%)	Ash(%)	Carbohydrate(%)
100BW+XG	15.26 ± 0.5^{C}	15.1 ± 0.2^{D}	15.8 ± 0.1^{B}	0.50 ± 0.1^{AB}	1.20 ± 0.1^{C}	51.94 ± 0.1^{F}
100W+XG	15.70 ± 0.2^{BC}	16.0 ± 0.2^{BC}	9.83 ± 0.3^{H}	0.60 ± 0.1^{A}	1.32 ± 0.2^{AB}	56.2 ± 0.3^{A}
50BW+50W+XG	15.56 ± 0.3^{BC}	16.5 ± 0.2^{AB}	10.63 ± 0.3^{G}	0.63 ± 0.5^{A}	1.48 ± 0.4^{ABC}	55.86 ± 0.1^{B}
75BW+25W+XG	15.60 ± 0.2^{BC}	15.5 ± 0.4^{D}	13.53 ± 0.1^{D}	0.56 ± 0.1^{AB}	1.81 ± 0.1^{A}	53.0 ± 0.2^{C}

All readings were taken in triplicates at ($P<0.05$)
Means followed by same superscripts in rows do not differ significantly
BW+XG= Buckwheat flour + xanthan gum, W+XG= Wheat flour + xanthan gum
Table 3 Proximate composition of buckwheat cookies with xanthan gum





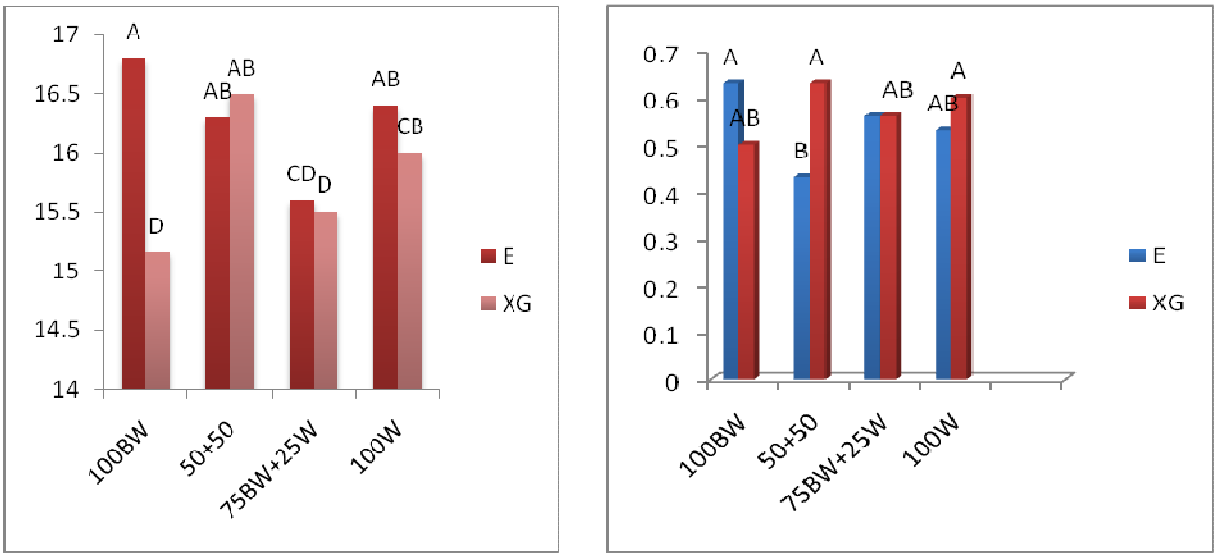


Fig 1: Comparison of formulated buckwheat cookies (a) protein (left above), (b) ash (right above) (c) fat (left below) (d) crude fibre (right below)

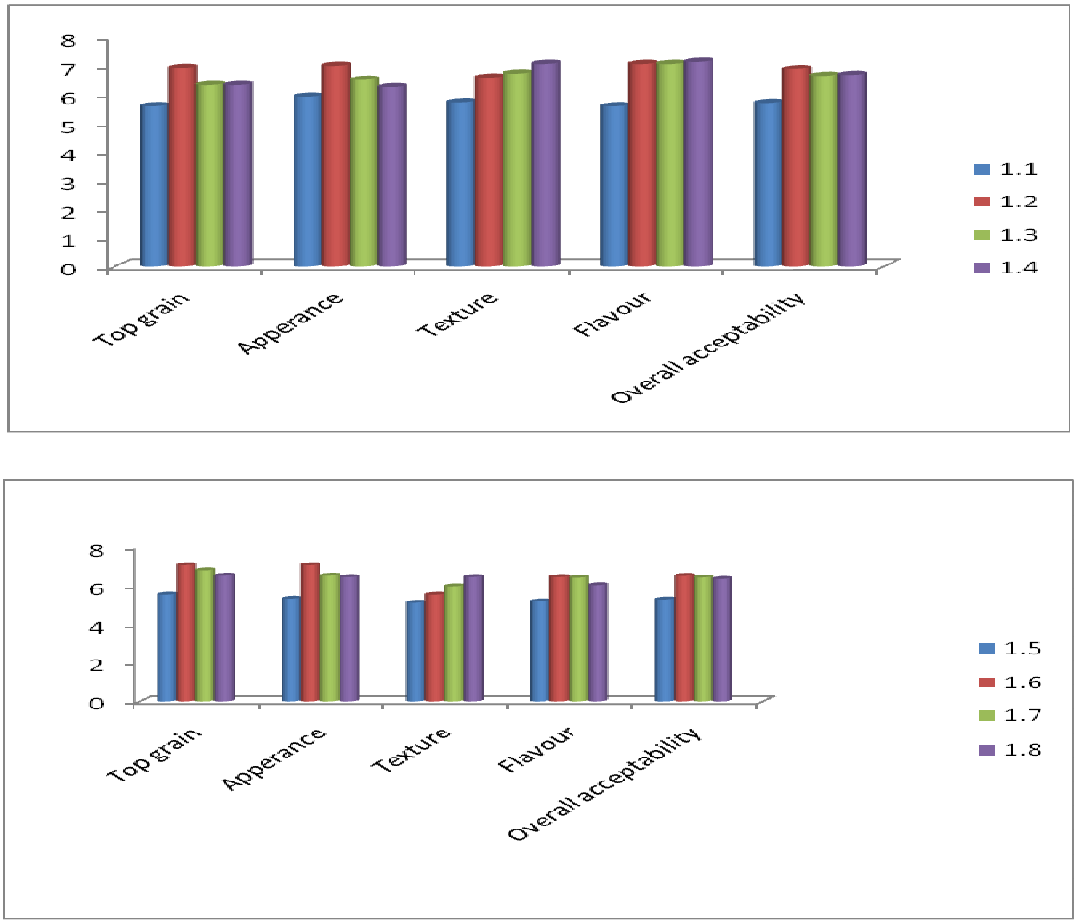


Fig 2: Sensory characteristics of cookies as affected by incorporation of buckwheat flour (a) with egg (left), (b) with xanthan gum (right)