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# Evaluation of Sensory Attributes Biscuits Developed using Single and Multiple Blend Nutraceuticals

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**ABSTRACT**

*The present study was undertaken with an aim of developing biscuits using single and multiple blend nutraceuticals biscuits using functional ingredient like foxtail millet flour, flaxseed flour, rice bran oil and carrot flour and to assess its Organoleptic evaluation and physical quality. Acceptability trials were conducted by a semi-trained panel consisting of 15 members of Department of Food Science and Nutrition and Department of Horticulture against nine point hedonic scale. Analysis of variance (ANOVA) in completely randomized design was done and the means were tested for significance at 5% probability level to find out whether products differed significantly from each other for all the quality attributes. Three formulations namely SB1, SB2, and SB3 were developed under single blend nutraceutical biscuits. Similarly four formulations namely MB1, MB2, MB3 and MB4 were developed under multiple blend nutraceutical biscuits. Under each formulations, three products were developed at different level of incorporation 20%(A) , 30%(B) and 40%(C) and were subjected to acceptability trials. Out of the three product prepared from SB1 formulation, SB1A (20% foxtail millet flour) exhibited highest scores for all the sensory attributes in terms In case of SB2 formulation, SB2B (30% flaxseed flour) exhibited highest scores for sensory attributes among the three product developed from SB2 formulation in terms of all sensory attributes.Similarly in case of SB3A (20% carrot flour ) exhibited highest scores out of the three product prepared from SB3 formulation for all the sensory attributes Similarly out of the three products under MB1 formulation, MB1A (20% foxtail-millet flour +flaxseed flour) exhibited highest scores for all the sensory attributes In case of MB2, MB2A (20% flaxseed flour+ carrot flour) had the highest mean score among the three products developed under MB2 formulation.In case of MB3 formulation, MB3A (20% foxtail-millet flour + flaxseed flour + carrot flour) exhibited highest scores for sensory attributes among the three products developed under MB3 formulation .Similarly in case of MB4A (20% carrot flour + flaxseed flour) exhibited highest scores among the three products developed under MB4 formulation for sensory attributes.*

***Keywords:*** *Formulation, Blend, Nutraceuticals, Sensory, Attributes*

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## INTRODUCTION

In developing countries like India with the increasing urbanization, technological, industrial and economic advances, the demand of processed food is also increasing rapidly. Among the processed foods, bakery products, particularly biscuits command wide popularity in rural as well as urban areas among all the age groups. Biscuits are one of the most popular widely consumed processed food product in India. 80% of bakery products like bread and biscuits are consumed on regular basis by common people in India[1]. Biscuits possess several attractive features including wider consumption, low cost among other processed foods, varied taste, easy availability and good eating quality and relatively long shelf-life[3,5]. Biscuits are high in carbohydrate, fat, calorie and low in fibre, vitamins and minerals which make them unhealthy for daily consumption but due to their acceptability in all age groups, longer shelf-life, better taste it is considered as a good product for fortification[11]. Since last two decades emphasis have been given in the development of novel fortified value added food products for promoting better health and lifestyle and reduction of micronutrient deficiencies among the population in both developed and developing countries[5]. Out of different fortified food products biscuit rank third next to breakfast cereals and fruit juices, and are the most popular snack product world-wide. Foods can be fortified with nutraceuticals to enhance their nutrition as well as provide health benefits. Nutraceutical is a term coined to describe substances which are not traditionally recognized nutrients but which have positive physiological effects on the human body. They do not easily fall into the legal category of food and drug and often inhabit a grey area between the two[13]. The term "nutraceutical" was coined from "nutrition" and "pharmaceutical" in 1989 by Stephen DeFelice, MD, founder and chairman of the Foundation for Innovation in Medicine (FIM), Cranford. According to DeFelice, nutraceutical can be defined as, "a food (or part of a food) that provides medical or health benefits, including the prevention and treatment of a disease[4]". Nutraceuticals found in food are anti-oxidants like carotenoids (found in carrots), lycopene, dietary fibres (found in foxtail millet and flaxseeds), gamma oryzonal (found in rice-bran oil), omega-3 fatty acids etc which helps in prevention of various diseases like cancer, osteoporosis, helps in digestion, and also plays a major role in preventing metabolic disorders like diabetes.

## MATERIALS AND METHOD

### Selection of Samples

Flaxseed, foxtail millet, carrot and rice bran oil were selected for the present study due to their easy availability, accessibility, high therapeutic value and nutraceutical properties.

### *Procurement of raw materials*

For carrying out the present study required samples were procured from the local market of Jorhat, district of Assam and Dimapur district of Nagaland.

### *Processing of raw materials*

The raw ingredients were processed to make them ready for product development. All the raw ingredients i.e. foxtail millet, flaxseed and carrots were processed into flour in order to incorporate them for development of single and multiple blend nutraceutical biscuits.

### *Processing of flaxseed into flour*

Flaxseeds were cleaned, dried and roasted, roasting was performed with a household microwave oven with 480W output, under the operating frequency of 2450MHz for 2.5 minutes according to method described by Hongzhi *et al*[7]. Roasted flaxseed were ground in domestic mixer and passed through 400 µ sieve according to method outlined by Ganorkar and Jain[6]. The process of making flaxseed flour is depicted in Fig. 3.1.

### *Processing of foxtail millet into flour*

The foxtail millet grains were cleaned, de-husked by hand pounding and grinded in a commercial roller mill. The flour was sieved using a BS 40-mesh sieve. The flour and was stored in stainless steel containers[9]. The process of making foxtail millet flour is depicted in Fig. 3.2.

***Processing of carrot into flour***

The processing of carrot into flour was done by using the method outlined by Pitchiah[14]. Carrot purchased from a local market were cleaned, trimmed, washed, peeled and cut into 1 cm slices and were blanched at 100°C for 3 minutes. After blanching slices were kept in cold water 10 minutes and they were taken out and were oven dried at 65°C for 3 days. The dried carrots were milled through satake testing mill- TM 05 and sieved through a 60 mesh size sieve and stored in an airtight container.

**Formulation of Biscuits**

The biscuits were developed from flour mix prepared by substituting wheat flour with foxtail millet flour, flaxseed flour and carrot flour at different level of incorporation. For development of single and multiple blend nutraceutical biscuits the flour mix was prepared in three different ratios *viz*., 80:20, 70:30, and 60:40 respectively and were used to prepare 100 gm flour mix for biscuits. For multiple blend biscuits 50% of shortening was replaced with rice bran oil (Table 3.2 and 3.3). The biscuits were prepared following the guidelines outlined by AACC[2] (Anon., 1990) American Association of Cereal Chemists (Table 3.1).

***Development and Standardization of Biscuits:***

The biscuits were developed from flour mix prepared by substituting wheat flour with foxtail millet flour and flaxseed flour at different level of incorporation. For development of single and multiple blend nutraceutical biscuits the flour mix was prepared in three different ratios viz. 80:20, 70:30, and 60:40 respectively and were used to prepare 100gm flour mix for biscuits The biscuits were prepared following the guidelines outlined by AACC[2] American Association of Cereal Chemists

***Acceptability trials of formulated biscuits***

Sensory evaluation has been defined as a scientific discipline used to evoke, measure, analyse and interpret those responses to products as perceived through the senses of sight, smell, touch, taste and hearing.

## RESULTS AND DISCUSSION

**Formulation and standardization of biscuits**

The biscuits were developed from flour mix prepared by substituting wheat flour with foxtail millet flour and flaxseed flour at different level of incorporation. For development of nutraceutical biscuits the flour mix was prepared in three different ratios *viz.* 80:20, 70:30, and 60:40 respectively and were used to prepare 100gm flour mix for biscuits. For multiple blending of biscuits 50% of shortening was replaced with rice bran oil (Table 2 and 3). The biscuits were prepared following the guidelines outlined by AACC[2] American Association of Cereal Chemists (Table 1).

**Acceptability trials of the formulated single and multiple blend nutraceutical biscuits**

Acceptability of a product is determined by sensory evaluation. Sensory evaluation has been defined as a scientific discipline used to evoke, measure, analyze and interpret those responses to products as perceived through the senses of sight, smell, touch, taste and hearing. Sensory analysis can be considered to be an interdisciplinary science that uses human panelists sensory perception related to thresholds of determination of attributes, the variance in individual sensory response to measure the sensory characteristics and the acceptability of food products. Since there is no one instrument that can replicate or replace the human psychological and emotional response, the sensory evaluation component of any food study is very essential.

Acceptability trials were conducted by a semi-trained panel consisting of 15 numbers of judges from the Department of Food science and Nutrition and Department of Horticulture respectively. Scoring was done on nine point hedonic scale. The acceptable level of incorporation of foxtail millet flour, flaxseed flour and carrot flour in biscuits was assessed by incorporating 20%, 30% and 40% of each flour in wheat flour (Table 2 and 3) and standardized for sensory characteristics. For Sensory evaluation of single blend nutraceutical biscuits three formulations were developed namely SB1 (foxtail millet flour)

SB2 (flaxseed flour), and SB3 (carrot flour) by substituting wheat flour with foxtail millet flour, flaxseed flour and carrot flour to the standard biscuit formulation outlined by American Association of Cereal Chemists, AACC method[2]. Under each formulation three products were developed at different level of incorporation 20%, 30% and 40% respectively to find out the acceptability of the product. Similarly for multiple blend nutraceutical biscuit four formulations were developed namely MB1 (Foxtail-millet flour + flaxseed flour + rice-bran oil), MB2 (Foxtail millet flour + carrot flour + rice-bran oil), MB3 ((Foxtail millet flour + carrot flour + flaxseed flour + rice-bran oil) and MB4 (Flaxseed flour + carrot flour + rice-bran oil) by substituting wheat flour with foxtail millet flour, flaxseed flour and carrot flour to the standard biscuit formulation outlined by American Association of Cereal Chemists, AACC method[2], 50% of the shortening was replaced by rice bran oil in multiple blend biscuits.

**Table 1: List of ingredients outlined American Association of Cereal Chemists, AACC method[2] (Anon 1990)**

| Ingredients | Quantity |
|---|---|
| Flour | 100 g |
| Sugar | 56 g |
| Salt | 1 g |
| Sodium bicarbonate | 1.11 g |
| Shortening | 40 g |
| Dextrose | 14.4 ml |
| Water | Optimum |

**Table 2: Formulation of single blend nutraceutical biscuits**

| Formulations | Level of incorporation | | | |
|---|---|---|---|---|
| | Refined wheat flour | foxtail millet flour | flaxseed flour | carrot flour |
| SB1A | 80% | 20% | - | - |
| SB1B | 70% | 30% | - | - |
| SB1C | 60% | 40% | - | - |
| SB2A | 80% | - | 20% | - |
| SB2B | 70% | - | 30% | - |
| SB2C | 60% | - | 40% | - |
| SB3A | 80% | - | - | 20% |
| SB3B | 70% | - | - | 30% |
| SB3C | 60% | - | - | 40% |

*SB-Single Blends*
*SB1-Foxtail millet biscuits*
*SB2-Flaxseed biscuits*
*SB3-Carrot powder biscuits*
*A-20% incorporation*
*B-30% incorporation*
*C-40% incorporation*

**Table 3: Formulation of multiple blend nutraceutical biscuits**

| Formulations | Level of incorporation for flour | | | | Level of incorporation for fat | |
|---|---|---|---|---|---|---|
| | Refined wheat flour | Foxtail millet flour | Flaxseed flour | Carrot flour | Shortening | Rice bran oil |
| MB1A | 80% | 10% | 10% | - | 50% | 50% |
| MB1B | 70% | 15% | 15% | - | 50% | 50% |
| MB1C | 60% | 20% | 20% | - | 50% | 50% |
| MB2A | 80% | 10% | - | 10% | 50% | 50% |
| MB2B | 70% | 15% | - | 15% | 50% | 50% |
| MB2C | 60% | 20% | - | 20% | 50% | 50% |
| MB3A | 80% | 6.6% | 6.6% | 6.6% | 50% | 50% |
| MB3B | 70% | 10% | 10% | 10% | 50% | 50% |
| MB3C | 60% | 13.3% | 13.3% | 13.3% | 50% | 50% |
| MB4A | 80% | - | 10% | 10% | 50% | 50% |
| MB4B | 70% | - | 15% | 15% | 50% | 50% |
| MB4C | 60% | - | 20% | 20% | 50% | 50% |

MB- Multiple Blends
MB1-Foxtail and flaxseed biscuits
MB2-Foxtail millet and carrot powder biscuit
MB3-Foxtail millet flaxseed and carrot powder biscuit
MB4-Flaxseed and carrot powder biscuit
A-20% incorporation
B-30% incorporation
C-40% incorporation

**Table 4: Mean acceptability scores of single blend formulations**

| Formulations | Products | Quality attributes | | | | | |
|---|---|---|---|---|---|---|---|
| | | Colour | Appearance | Taste | Flavour | Crispness | Overall acceptability |
| Control | | $8.40^{a}$ | $8.00^{a}$ | $8.40^{a}$ | $8.50^{a}$ | $8.33^{a}$ | $8.46^{a}$ |
| SB1 | SB1A | $7.73^{b}$ | $7.66^{a}$ | $8.50^{a}$ | $8.63^{a}$ | $7.93^{a}$ | $8.16^{a}$ |
| | SB1B | $7.23^{c}$ | $7.30^{a}$ | $7.20^{b}$ | $7.43^{b}$ | $7.23^{b}$ | $7.36^{b}$ |
| | SB1C | $7.20^{c}$ | $7.03^{b}$ | $7.20^{b}$ | $7.03^{b}$ | $7.06^{c}$ | $7.16^{b}$ |
| SB2 | SB2A | $7.43^{c}$ | $7.20^{b}$ | $7.50^{b}$ | $7.43^{b}$ | $7.73^{b}$ | $7.50^{b}$ |
| | SB2B | $7.73^{b}$ | $7.26^{b}$ | $7.53^{a}$ | $7.76^{a}$ | $7.96^{a}$ | $7.93^{a}$ |
| | SB2C | $7.00^{c}$ | $6.93^{b}$ | $6.93^{b}$ | $7.16^{b}$ | $7.50^{b}$ | $7.30^{b}$ |
| SB3 | SB3A | $4.33^{d}$ | $4.40^{c}$ | $6.10^{b}$ | $6.03^{b}$ | $7.46^{b}$ | $6.06^{b}$ |
| | SB3B | $4.00^{d}$ | $4.13^{c}$ | $5.00^{c}$ | $5.50^{c}$ | $7.16^{b}$ | $5.83^{c}$ |
| | SB3C | $3.50^{d}$ | $4.06^{c}$ | $4.86^{c}$ | $4.00^{c}$ | $7.03^{c}$ | $4.50^{c}$ |
| $CD_{0.05}$ | | 0.54 | 0.46 | 0.60 | 0.48 | 0.62 | 0.51 |

SB-Single Blends
SB 1- foxtail millet biscuits
SB2- flaxseed biscuit
SB3- carrot powder biscuits
A-20% incorporation
B-30% incorporation
C-40% incorporation
Means within column separated by Duncan's multiple range test $P < 0.05$
Means followed by the same letter shown in superscript(s) are not significantly different

**Table 5: Mean acceptability scores of multiple blend formulations**

| Formulations | Products | Quality attributes | | | | | |
|---|---|---|---|---|---|---|---|
| | | Colour | Appearance | Taste | Flavour | Crispness | Overall acceptability |
| Control | | 8.43 [a] | 8.00[a] | 8.43[a] | 8.50[a] | 8.33[a] | 8.35[a] |
| MB 1 | MB1A | 8.02[a] | 7.96[a] | 7.50[b] | 7.87[b] | 7.94[b] | 8.12[a] |
| | MB1B | 7.66[b] | 7.51[b] | 7.21[d] | 7.52[d] | 7.86[b] | 7.75[c] |
| | MB1C | 7.43[c] | 7.03[d] | 7.00[e] | 7.20[f] | 7.50[d] | 7.65[d] |
| MB 2 | MB2A | 7.73[b] | 7.66[a] | 7.85[b] | 7.93[b] | 7.96[b] | 8.07[a] |
| | MB2B | 7.56[b] | 7.43[b] | 7.60[b] | 7.76[b] | 7.76[c] | 7.87[b] |
| | MB2C | 7.20[d] | 7.13[c] | 7.40[c] | 7.43[e] | 7.46[d] | 7.57[d] |
| MB3 | MB3A | 7.73[b] | 7.53[b] | 7.93[a] | 8.00[b] | 8.00[b] | 8.08[a] |
| | MB3B | 7.43[c] | 7.36[b] | 7.65[b] | 7.63[c] | 7.43[d] | 7.65[d] |
| | MB3C | 7.30[d] | 7.00[e] | 7.20[d] | 7.30[e] | 7.21[e] | 7.52[e] |
| MB4 | MB4A | 7.93[a] | 7.53[b] | 8.00[a] | 7.93[b] | 7.73[c] | 8.06[a] |
| | MB4B | 7.60[b] | 7.30[b] | 7.72[b] | 7.66c | 7.23[e] | 7.25[f] |
| | MB4C | 7.30[d] | 7.00[e] | 7.42[c] | 7.20e | 7.16[f] | 7.02[f] |
| $CD_{0.05}$ | | 0.54 | 0.39 | 0.52 | 0.59 | 0.48 | 0.37 |

MB- Multiple Blends
MB1-Foxtail and flaxseed biscuits
MB2-Foxtail millet and carrot powder biscuit
MB3-Foxtail millet flaxseed and carrot powder biscuit
MB4-Flaxseed and carrot powder biscuit

A-20% incorporation
B-30% incorporation
C-40% incorporation

Means within column separated by Duncan's multiple range test $P< 0.05$
Means followed by the same letter shown in superscript(s) are not significantly different

Under each formulation three products were developed at different level of incorporation i.e. 20%, 30% and 40% respectively to find out the acceptability of the product. The trial was conducted thrice to arrive at consistent scores.

Table 4 revealed that out of the three product prepared from SB1 formulation SB1A (20% foxtail millet flour) exhibited highest scores for all the sensory attributes in terms of colour (7.73), appearance (7.66), taste (8.50), flavor ( 8.63), crispness (7.93) and overall acceptability (8.16) and was found to be statistically at par with the control biscuits. In case of SB2 formulation, SB2B (30% flaxseed flour) exhibited highest scores for sensory attributes among the three product developed from SB2 formulation in terms of colour (7.73), appearance (7.26), taste (7.53), flavour (7.76), crispness (7.96), and overall acceptability (7.73) and was statistically at par with the control biscuit. Similarly in case of SB3A (20% carrot flour) exhibited highest scores out of the three product prepared from SB3 formulation for all the sensory attributes in terms of colour (4.33), appearance (4.40), taste (6.10), flavour (6.03), crispness ( 7.46), and overall acceptability (6.06) and showed significant difference from contol biscuits ($P< 0.05$). Similarly in multiple blend formulation, from Table 5 it was revealed that out of three products under MB1 formulation MB1A (20% foxtail-millet flour +flaxseed flour) exhibited highest scores for all the sensory attributes in terms of colour (8.00), appearance (7.96), taste (7.46), flavour (7.86), crispness (7.93) and overall acceptability (7.80). In case of MB2A (20% flaxseed flour+ carrot flour) had the highest mean score in terms of colour (7.73), appearance (7.66), taste (7.86), flavor (7.93), crispness (7.96) and overall acceptability (7.76) among the three products developed under MB2 formulation. In case of MB3 formulation, MB3A (20% foxtail-millet flour +flaxseed flour+ carrot flour) exhibited highest

scores for sensory attributes among the three products developed under MB3 formulation in terms of colour (7.73), appearance (7.53), taste (7.93), flavor (8.00), crispness (8.00) and overall acceptability (8.00). Similarly in case of MB4A (20% carrot flour +flaxseed flour) exhibited highest scores among the three products developed under MB4 formulation for sensory attributes in terms of colour (7.93), appearance (7.53), taste (8.00), flavor (7.93), crispness (7.73) and overall acceptability (7.66). All the four biscuits namely MB1A, MB2A, MB3A and MB4A were found statistically at par with the control biscuits. During the acceptability trials it was observed that sensory attributes decreased at 40% incorporation level for each biscuit. At this level of incorporation the colour was also affected i.e. the biscuits developed dark colour as incorporation level increased and in flaxseed biscuits bitterness was also found by panel member.

Several studies have reported that biscuits prepared from millet flours added with wheat flour at different level of incorporation were highly acceptable[16]. Meghana[10] also reported that 40% incorporation of foxtail millet to wheat flour for development of biscuits obtained acceptable sensory characteristics along with increase in the fiber and nutrients. However the present study revealed that the sensory scores decreased significantly ($p<0.05$) with increase in the level of incorporation of composite flour. Similar findings were also reported by Rathi[15] who stated that incorporation of flaxseed flour at 40% incorporation level was unacceptable in biscuit and decreased the sensory attributes of biscuits in terms of colour and flavor whereas 30% incorporation produced good results. Hussain *et al*[8]., also developed cookies by using flaxseed flour supplemented with wheat flour up to 40% level and reported that mean quality scores of the cookies decreased with the increase in the level of the flaxseed flour supplementation. Nagarajaiah[12] also reported that a higher level of incorporation of carrot flour in cookies decreased the sensory scores of the biscuits.

## CONCLUSION

It is evident from the present study that the biscuits can be made with substitution of wheat flour with nutraceuticals like flaxseed flour, foxtail millet flour, carrot flour without affecting the sensory attributes. These fortified biscuits are nutritionally superior to that of refined wheat flour biscuits and utilization of such functional ingredients will improve the overall health of the population as well as prevent the onset of degenerative disease and help in management of metabolic disorder like diabetes and obesity.

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