Effect of legume supplementation on physical and textural characteristics of ready to eat cereal bars

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ABSTRACT

The present study was carried out to find the effect of legume supplementation on physical and textural characteristics of ready to eat cereal bars. Therefore, physical and textural parameter of ready to eat cereal bars was analyzed. Results showed that the length, width and thickness of the bars ranged between 9.69±0.29 to 10.02±0.01 cm, 4.52±0.02 to 4.90±0.05 cm and 0.85±0.04 to 0.99±0.01 cm. Whereas spread ratio, per cent spread, volume, weight and density was found to range between 4.90±0.11 to 5.30±0.30, 92.43±1.03 to 100.00 per cent, 38.63±2.23 to 47.85±1.18 cm$^3$, 24.76 to 25.14 g and 0.52±0.00 to 0.67±0.00 (g/cm$^3$) respectively. Hardness of selected RTE cereal bar varied from 4901.13±2.08 to 13800.79 (g force). Significant difference was observed between control (CCB) and among all the other treatments (RCCB, PCCB, RSCB, PSCB and DSCB) due to increase in the incorporation level of legume flour.

Key words: Cereal bar, Legume supplementation, Physical parameter, RTE, Textural parameters.

INTRODUCTION

Today’s food consumers, driven by changing demographics and life styles have adopted different patterns of food consumption, in turn leading to differences in menu planning, food acquisition and food preparation. The changing role of women in society, specifically the increase in the percentage of adult women working, has been the single most important factor impacting food preparation and consumption patterns. As a result, convenience has become a significant driving force in the food industry. Time has become the currency of the present era. This has resulted in enhanced demand for pre-packaged and pre-cooked Ready-to-Eat (RTE) foods.

Increasing demand from consumers for nutritious snacks, have prompted the food industry to develop food bars that combine convenience and nutrition (Izzo and Ninness, 2001). The food bars are snack foods of good sensory and nutritional characteristics due to their high content of proteins, lipids and carbohydrates (Estevez et al. 2000). There are variety of food bars available in the global market such as cereal bars, nutrition bars, diet bar etc. Moreover, other snack bars are available including fruit bars, crunchy bars, salty bars, low-calorie bars and diet bars. Furthermore, bars with filling, bars with chocolate, bars without chocolate and bars with potentially functional additives such as prebiotics are also available. These all offer specific benefits for the target consumers. These are ready to use, thus lure the school going children, office workers and athletes to maintain their energy level and can even be supplied to the target populations in the situation of an emergency (Omer et al. 2009).

Cereal bars are practical, easy to manufacture and depending on the ingredients used can be sold at a low price. These products can be conveniently added to a packed lunch or eaten as a snack. (Luciana et al. 2011). These products contain some processed cereals including wheat, oat, rice, barley as the main ingredient and others include nuts, fruit chunks, chocolate chips or coatings. To supply the public with nutritious food alternatives of junks, the nutrient dense food bars could be a good candidate. Food bars are the snack foods of good sensory characteristics due to their nutrient combinations. One of the strategies to produce the food bars with good protein quality is cereal-legume complementation. Thus keeping these things in mind the present research study was undertaken with a specific objective that is to assess the effect of legume supplementation on physical and textural characteristics of ready to eat cereal bars.

MATERIALS AND METHODS

Present study was undertaken to find out the effect of legume supplementation on physical and textural characteristics of ready to eat cereal bars. Selection of the most acceptable treatment in each RTE Cereal Bars was based on the highest magnitude of preference as inferred by the overall acceptability scores and the most acceptable treatment was selected for the analysis of physical and
textural characteristics (length, width, thickness, spread ratio, per cent spread, volume, density and hardness). Samples were measured by method described under:

i) **Width and length**: Six cereal bars were placed edge to edge and their total width was measured with a vernier caliper (0.01 mm accuracy). The average width was determined by taking the mean value (Nouman et al., 2003). Similarly the cereal bars length was determined by placing the butt of six cereal bars and taking the mean value.

ii) **Thickness**: To determine the thickness, six cereal bars were placed on top of one another. The total height was measured in millimeters with a ruler. The measurement was repeated thrice to get an average value and results were reported in cm (AACC, 2000)

iii) **Weight**: of cereal bars was measured as average of values of four individual cereal bars with the help of digital weighing balance.

iv) **Spread ratio**: was calculated by dividing the average value of width by average value of thickness of cereal bars by the method of Akubor and Ukwuru, (2003), using the following formula:

\[ SF = \frac{W}{T} \]

where as W=Width cereal bars (cm), T = Thickness cereal bars (cm)

v) **Per cent spread**: was calculated by dividing spread ratio of supplemented bars with spread ratio of control bars and multiplying by 100 (Baljeet et al. 2010)

vi) **Volume**: of cereal bars was calculated using length (L), width (W) and thickness (T) using the following formula:

\[ \text{Volume (cm}^3\text{)} = L \times W \times T \]

where as L = average length of cereal bars (cm) ,W = average width of cereal bars (cm) and T = average thickness of cereal bars (cm)

vii) **Density**: After calculating volume, density was obtained from the ratio between weight and volume (Srivastava et al. 2012)

\[ \text{Density (g/cm}^3\text{)} = \frac{\text{Weight (g)}}{\text{Volume (cm}^3\text{)}} \]

viii) **Texture Profile Analysis (TPA)**: The texture of the cereal bars were also evaluated objectively using texture analyzer TA.HD.Plus. Standard procedure given in the specifications of the equipments was used. The texture analyzer is a microprocessor controlled texture analysis system (stable micro systems), which can be interfaced to a wide range of peripherals, including computers. One main strength of this equipment is its versatility. The hardness of the product was measured in terms of the maximum peak force during the first compression cycle (first bite) and often been substituted by term firmness.

**Texture Analysis (TA) settings and parameters :**

- **Sequence Title**: Return to Start
- **Test Mode**: Compression
- **Pre-Test Speed**: 1.00mm/sec
- **Test Speed**: 0.50 mm/sec
- **Post-Test Speed**: 10.00mm/sec
- **Target Mode**: Distance
- **Force**: 100.0g
- **Distance**: 5.000mm
- **Trigger Type**: Auto (Force)
- **Trigger Force**: 5.0g
- **Probe**: P/5; 5mm Dia Cylinder stainless steel
- **Points per second**: 200

**Statistical analysis:** Results obtained were analyzed by ANOVA one way classification.

**RESULTS AND DISCUSSION**

The result of the physical parameters of the selected RTE cereal bars are shown in Table 1. The length of cereal bars ranged from 9.69 ± 0.29 to 10.02 ± 0.01 cm. The result shows that PSCB (10.02 ± 0.01) had maximum length followed by RSCB (10.01 ± 0.01) and DSCB (10.01 ± 0.01) where as RCCB and PCCB both had minimum length i.e., 9.69 ± 0.29cm. The width of RTE cereal bars increased after the substitution of legume flours. The result shows that control cereal bar had the minimum width 4.52 ± 0.25cm lower than other treatments 4.88 ± 0.06cm (RCCB), 4.90 ± 0.05cm (PCCB), 4.83 ± 0.02cm (RSCB), 4.84 ± 0.01cm (PSCB) and 4.76 ± 0.04cm (DSCB). The results are similar with the findings of chinma et al. (2011), who observed that biscuit prepared from pigeon pea flour blends were significantly (p<0.05) higher in width than 100% wheat flour biscuit. Also Ajanaku et al., (2011), who reported that the width and the thickness of cookies increased with addition of brewery spent grain and the spread ratio decreased in all blends in comparison with control cookies.

The weight of biscuit increased as the concentration of legume flour increased in the RTE cereal bars. The range of RTE cereal bars weight was 24.76 ± 0.22 to 25.14 ± 0.08g

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Length (cm)</th>
<th>Width (cm)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Cereal Bar (CCB)</td>
<td>10.01 ± 0.01</td>
<td>4.52 ± 0.02</td>
<td>25.140 ± 0.08</td>
</tr>
<tr>
<td>Raw Chickpea Cereal Bar (RCCB) (30%)</td>
<td>9.69 ± 0.29</td>
<td>4.88 ± 0.06</td>
<td>24.760 ± 0.22</td>
</tr>
<tr>
<td>Processed Chickpea Cereal Bar (PCCB) (30%)</td>
<td>9.69 ± 0.29</td>
<td>4.90 ± 0.05</td>
<td>24.856 ± 0.14</td>
</tr>
<tr>
<td>Raw Soyabean Cereal Bar (RSCB) (40%)</td>
<td>10.01 ± 0.01</td>
<td>4.83 ± 0.02</td>
<td>25.013 ± 0.03</td>
</tr>
<tr>
<td>Processed Soyabean Cereal Bar (PSCB) (40%)</td>
<td>10.02 ± 0.01</td>
<td>4.84 ± 0.01</td>
<td>25.016 ± 0.02</td>
</tr>
<tr>
<td>De-Fatted Soyabean Cereal Bar (DSCB) (20%)</td>
<td>10.01 ± 0.01</td>
<td>4.76 ± 0.04</td>
<td>25.026 ± 0.06</td>
</tr>
<tr>
<td>CD5%</td>
<td>0.30</td>
<td>0.07</td>
<td>0.21</td>
</tr>
</tbody>
</table>
with maximum value 25.00 ± 0.06g of DSCB followed by 25.01 ± 0.02g of PSCB except control cereal bar i.e., 25.14 ± 0.08g. The increase in cereal bar weight was probably due to the availability of legume flours to retain oil during baking process (Rufeng et al., 1995). The result obtained agreed with Baljeet et al., (2010) reported that the weight of biscuit increased as the concentration of BWF increased in the blends.

The thickness of cereal bars ranged from 0.85 ± 0.04 to 0.99 ± 0.01cm. It increased with the incorporation of legume flour. The result shows that PSCB (0.99 ± 0.01) had maximum thickness followed by RSCB (0.98 ± 0.01) and CCB (0.85 ± 0.04) had least thickness. The changes in thickness was reflected in spread ratio and per cent spread of RTE cereal bar (Fig. 1).

The spread ratio and per cent spread of control cereal bars were 5.30 ± 0.30 and 100.00 ± 0.00, respectively (Fig.2 and 3). Spread ratio and per cent spread decreased with increasing level of legume flour i.e., DSCB (20% incorporated DSF) spread ratio of 5.09 ± 0.47 and per cent spread of 96.03 ± 8.98, RCCB (30% incorporated RCF) spread ratio of 4.99 ± 0.09 and per cent spread of 94.20 ± 1.75, PCCB (30% incorporated PCF) spread ratio of 4.98 ± 0.10 and per cent spread of 93.95 ± 0.20, RSCB (40% incorporated RSF) spread ratio of 4.93 ± 0.08 and per cent spread of 93.31 ± 1.67, PSCB (40% incorporated PSF) spread ratio of 4.90 ± 0.11 and per cent spread of 92.43 ± 1.03.

The results of the present study are in tune with the findings of Singh et al. (1996) and Hooda and Jood (2005) they observed reduction in spread ratio when soya flour and fenugreek flour were substituted for wheat flour in biscuits. The results are also in line with Claughton and Pearce (1989) who reported a reduction in spread ratio of cookies by increasing the enrichment levels of sunflower protein isolates. Similarly Neha and Ramesh (2012) also reported a reduction in spread ratio of biscuits by increasing the enrichment levels with soya flour and rice bran.

Table.1 shows the effect of incorporation level of legume flours on volume and density of RTE cereal bars. The volume of RTE cereal bars increased linearly with increasing addition of legume flours ranging from 38.63 ± 2.23 for CCB to 47.85 ± 1.18 for PSCB (Fig.4) where as density decreased in similar manner with increasing addition of legume flours ranging from 0.67 ± 0.00 for control to 0.52 ± 0.00 for PSCB (Fig.5). The results are consistent with Simona et al., (2014), who reported that the volume of gluten free biscuits increased linearly with increasing addition of soy flour where as density decreased in the same manner. This may be due to higher protein content in the soya flour.
Fig 4: Effect of legume supplementation on volume (cm$^3$) of RTE cereal bars

Fig. 6 indicates the hardness (textural property) of RTE cereal bars incorporated with legume flours. The hardness of the legume supplemented cereal bars ranged from 6485.50 ± 0.50 to 13800 ± 5.19. As the legume flour percentage was increased in the cereal bars, hardness value decreased except the control cereal bars i.e., 4901.13 ± 2.08. These results are similar with Srivastava et al., (2010) who reported that addition of coconut meals in the biscuits decreased the hardness in his study on “effect of virgin coconut meal (VCM) on the textural, thermal and physiochemical properties of biscuits”. This might be due to decreasing gluten content and increase in fat content in the cereal bars. Statistically no significance difference was observed between control and treatments for length, width, thickness, spread ratio, volume, weight and hardness (P d” 0.05). When treatments were compared to control, significant increase in the density was observed due to increase in the protein content. Also significant difference was observed between control and PSCB for per cent spread among all the other treatments which did not differ significantly due to increase in the incorporation level of legume flour.

CONCLUSION

Therefore, it may be concluded that physical and textural properties of ready to eat cereal bars control and treatments (RCCB, PCCB, RSCB, PSCB and DSCB) were effected due to legume supplementation. It may be depend on quality and quantity of protein, per centage of supplementation and type of legume used in product development.

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