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Textural studies of soy-jambul seed powder fortified biscuits

■ M. M. PATIL AND S. B. KALSE

SUMMARY : The texture of food is one of the most challenging areas of food characteristics and main quality parameter affecting food preference. Therefore, the developed biscuits of compositions 60 per cent maida + 34 per cent soy flour + 6 per cent jambul seed powder for A_1, 60 per cent Maida+ 32 per cent soy flour + 8 per cent jambul seed powder for A_2 and 60 per cent Maida+ 30 per cent soy flour+ 10 per cent jambul seed powder for A_3 were allowed to texture profile analysis and their textural properties were compared with the control biscuit having 60 per cent Maida and 40 per cent soy flour obtained from the local market. Biscuit sample A_2 were found firm and crunchiness or crispier than other combinations.

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The texture refers to the structure and arrangement of particles in a substance. It encompasses all properties of foods which are perceived by kinesthetic and tactile senses of mouth. It is of topmost importance for palatability of food and an important attribute in that it affects processing and handling, influences food habits, and affects shelf-life and consumer acceptance of foods. Firmness, hardness or softness are textural properties that are generally on the same property spectrum. Firmness is the most commonly evaluated characteristic while determining biscuit texture. Depending upon the type of test conducted, firmness of biscuits can be obtained by measuring hardness, fracturability and work of shear (Stable Micro Systems).

Hardness is defined as the maximum peak force during the first compression cycle (first bite) and has often been substituted by the term firmness. Units are kg, g or N. Depending on different tests; it can also be measured as area under the curve (kg m) or first peak force (kg). Fracturability is a parameter that was initially called brittleness. The factor that helps determine fracturability is the suddenness (*i.e.* the distance at fracture) with which the food breaks. Sometimes it can also be given by linear distance. The linear distance function calculates the length of an imaginary line joining all points in the selected region. The greater the linear distance value the easier the sample is fractured.

MEMBERS OF RESEARCH FORUM

Author for Correspondence :
M. M. PATIL, Department of Processing and Food Engineering, Maharana Pratap University of Agriculture and Technology, UDAIPUR (RAJASTHAN) INDIA
E.mail : patil.megha2@gmail.com

Coopted Authors:
S. B. KALSE, Department of Processing and Food Engineering, Maharana Pratap University of Agriculture and Technology, UDAIPUR (RAJASTHAN) INDIA
E.mail : sandeep.kalse@gmail.com

Texture profile analysis (TPA):

The texture analyzer (TA) was a microprocessor controlled texture analysis system, which could be interfaced to a wide range of peripherals, including PC-type computers. The texture analyzer measured force, distance, and time in a most basic test, thus providing three dimensional product analyses. Forces could be measured against set distances and distances may be measured to achieve set forces. The probe carrier contained a very sensitive load cell. The TA-XT plus load cell had mechanical overload. The analyzer was linked to a computer that recorded the data via a software program Stable Micro System Exponents software (Stable Micro Systems) (plate 1).

Plat 1: A view of texture analyzer

EXPERIMENTAL METHODS

Penetration test by using cylindrical probe:

The penetration test is defined as one in which the depth of penetration was measured under a constant load. In a penetration test, the cylinder probe was made to penetrate into the test sample and the force necessary to achieve a certain penetration depth or the depth of penetration in a specified time, under defined conditions, was measured and used as an index of firmness.

The probe was 5 mm in diameter and 45 mm in length. A typical textural profile curve for biscuit by penetration test with one complete run is presented in Fig. A.

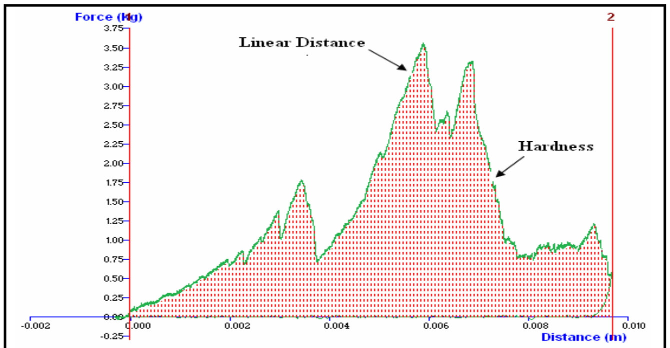

Fig A : Typical texture profile curve for biscuit firmness by penetration test

Cutting test by using blade set:

In cutting test, firmness of biscuit was obtained by determining hardness and work of shear. A single blade having 70 mm width and 90 mm length was used to cut/ shear through the sample of biscuit, under specified conditions. The heavy duty platform was repositioned so that there was no contact between the blade and slot surfaces and a 'blank' test run as a check. The blade was then raised to place of the sample. Samples were removed from their place of storage just prior to testing and allowed them to fit centrally on the platform under the knife edge. The blade was then allowed to shear through the sample. For comparison purposes, sample dimensions were kept constant. A typical textural profile curve for biscuit by cutting test with one complete run is presented in Fig. B.

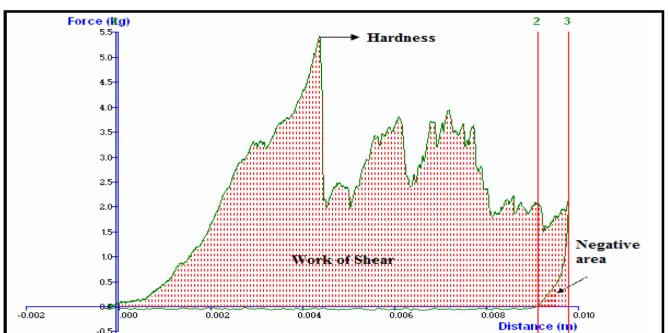

Fig B : Typical texture profile curve for firmness of biscuits by cutting test

Bending test by using three point bend rig :

In bending or snap test, firmness is represented by hardness and fracturability. The maximum peak force obtained in the curve and the distances at break indicate the hardness (kg) and fracturability (mm) of the product, respectively. In this test, the two adjustable supports of the rig base plate were placed a suitable distance apart so as to support the sample. The heavy duty platform was maneuvered and locked in a position that enables the upper blade to be equidistant from the two lower supports. The sample was placed centrally over the supports and 3 point bend rig which provides a variable support length up to 70 mm and width up to 80 mm was forced to bend the sample. A typical textural profile curve for biscuit by bending test with one complete run is presented in Fig C.

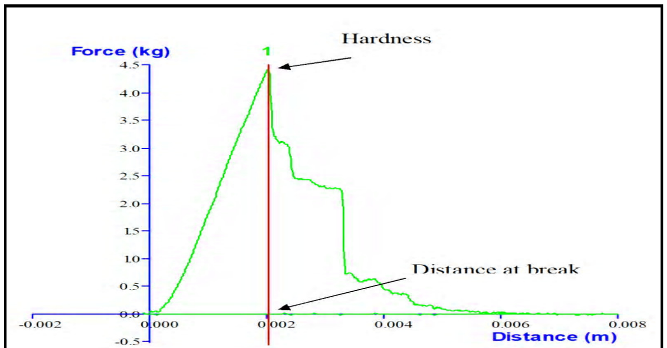

Fig C : Typical texture profile curve for biscuit firmness by bending test

Analysis of data:

Texture profile curves were obtained for different composition of biscuits. The textural properties such as hardness, fracturability and work of shear were determined. These data were graphically represented and the results were depicted from the trends obtained.

EXPERIMENTAL FINDINGS AND ANALYSIS

The results are summarized below according to objectives of the study:

Firmness by penetration test:

In penetration test, firmness is represented by hardness and fracturability. The area under the curve is taken as an indication of the hardness (kg m) and the linear distance as an indication of fracturability of the product during textural analysis. The linear distance function calculates the length of an imaginary line joining all points in the selected region. The greater the linear distance value, the easier the sample is fractured. As the probe started to penetrate in the sample the force required for breaking went on increasing until maximum resistance offered by the sample. Once the sample ruptured at certain distance, the force went on decreasing. Table 1 shows the mean values of hardness and fracturability of biscuit samples having different proportions of soy flour and jambul seed powder.

Table 1 : Hardness and fracturability of biscuit samples for penetration test

Biscuit	Firmness	
	Hardness (kg m) 'Mean area'	Fracturability 'Mean linear distance'
Control	0.0083	32.79
A_1	0.0076	32.75
A_2	0.0075	32.95
A_3	0.0066	32.67

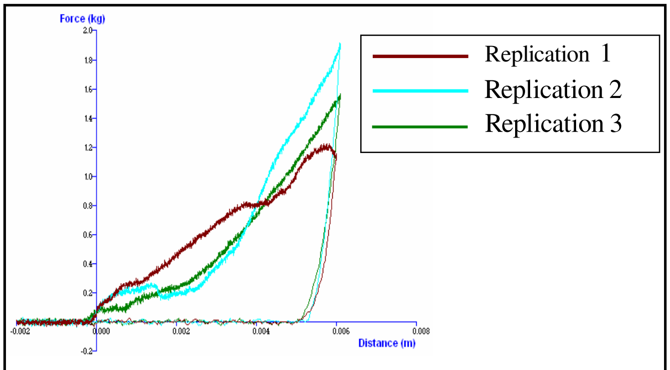

Fig 1 : Texture profile curve for biscuits by penetration test

It was seen from Table 1 that as the blend per cent of the jambul seed powder increased in the sample, the hardness went on decreasing. Control biscuit made by 60 per cent maida and 40 per cent soy flour shown maximum hardness about 0.0083 kg m. When 6 per cent of the soy flour was replaced by jambul seed powder, there was about 8.43 per cent decreases in its hardness. As increased in jambul seed powder from 6 to 8 per cent in the biscuit sample, hardness values decreased about 9.33 per cent. With further increased of the jambul seed powder from 8 to 10 per cent, the hardness values further reduced from 9.33 per cent to 20.48 per cent. The fracturability value of biscuit A_2 was 32.95 and greater than A_1 and A_3. Therefore, the combination A_2 having proportion of 32 per cent soy flour and 8 per cent jambul seed powder were more crispy or crunchy than others.

Firmness by cutting test:

From the Table 2 it is clear that the hardness of biscuits went on decreasing as the blend per cent of the jambul seed powder increased. The hardness values obtained for the biscuits of various blends at first peak were in the range of 3.56 to 6.13 kg. The shear force and work of shear to cut the sample was found highest for control biscuit.

Replacement of soy flour upto 10 per cent level with jambul seed powder in the biscuits recipe resulted in 41.92 per cent decrement in its hardness and 25 per cent of work required to shear the biscuit was also reduced. Therefore, the texture of biscuits A_1 was hard, A_2 was firm and A_3 was soft. However, A_2 biscuits having 8 per cent jambul seed powder and 32 per cent soy flour (8%:32%) had better firmness comparable to other combinations.

Table 2 : Hardness and work of shear of biscuit samples for cutting test

Biscuit	Firmness	
	Hardness (kg) 'Mean first peak force'	Work of shear (kg m) 'Mean total area'
Control	6.13	0.028
A_1	5.56	0.024
A_2	4.80	0.021
A_3	3.56	0.021

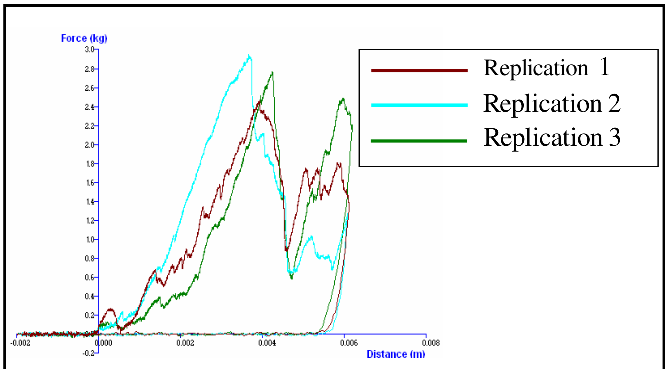

Fig 2 : Texture profile curve for biscuits by cutting test

Firmness by bending test

In bending or snap test, firmness was represented by hardness and fracturability. The maximum peak force obtained in the curve and the distances at break indicated the hardness (kg) and fracturability (mm) of the product respectively. In bending test, the hardness values obtained for the biscuits of various blends were in the range of 1.52 to 3.04 kg (Table 3). Similar values for hardness of biscuits have been reported by Onweluzo and Iwezu, (1998). When 6 per cent of the soy flour was replaced by jambul seed powder, hardness values decreased about 0.64 kg. As increased in jambul seed powder from 6 to 8 per cent in the biscuit samples, hardness values decreased about 0.58 kg. With further increased of the jambul seed powder from 8 to 10 per cent, the hardness values further reduced from 1.82 kg to 1.52g. It was observed that the hardness of biscuit reduced by increasing the percentage of jambul seed powder in soy biscuits and as jambul seed powder increased from 6 per cent to 10 per cent level, there was almost 1.5 kg reduction in hardness of soy biscuits (control).

Table 3 : Hardness and fracturability of biscuit samples for bending test

Biscuit	Firmness	
	Hardness (kg) 'Mean maximum force'	Fracturability (mm) 'Mean distance at break'
Control	3.04	3.65
A_1	2.40	2.81
A_2	1.82	2.42
A_3	1.52	4.19

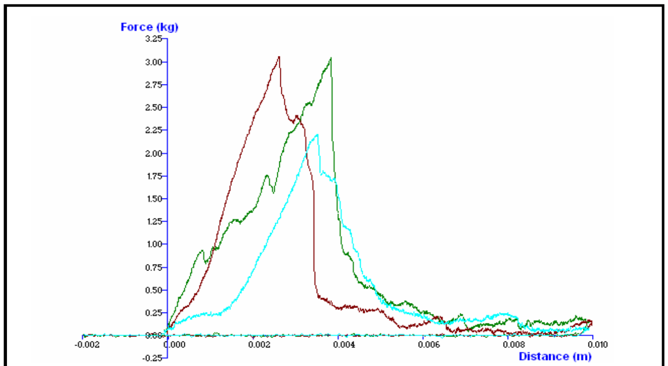

Fig 3 : Texture profile curve for biscuits A_2 by bending test

The biscuit sample A_3 having high jambul seed powder was fractured at maximum distance 4.19 mm indicating less crispiness. Therefore, more per cent of jambul seed powder than soy flour also affected the texture of biscuits by making them soft and less crispy. However, the more crispness was obtained for the biscuit sample having soy flour and jambul seed powder in 32 per cent and 8 per cent (32%:8%), respectively. Brown *et al.* (1998) and Darshan (2009) have also made similar type of investigations.

Conclusion:

– In penetration test, the fracturability value of A_2 biscuit (32.95) was greater than A_1 and A_3. Therefore, the combination A_2 was more crispy or crunchy than A_1 and A_3.

– In cutting test, the textural attributes were observed hard, firm and soft for biscuit combinations A_1, A_2 and A_3, respectively.

– The biscuit combination A_1 having 34 per cent soy flour exhibited maximum hardness value of 5.56 kg and maximum work of shear of 0.024 kg m hence, cutting force required to shear the biscuit having high per cent of soy flour is maximum.

– Sample A_2 breaks at a very short distance at 2.42 mm and has a high fracturability compared to other combinations.

– The biscuit sample A_3 having high jambul seed powder had minimum peak force and it breaks at maximum distance 4.19 mm which indicates its texture is soft and less crispy. Hence, decrease in soy flour and increase in jambul seed powder affected the texture of biscuits by making them soft and less crispy.

– From all three tests it has bean observed that the control biscuit having 60 per cent maida and 40 per cent soy flour exhibited maximum hardness for penetration, cutting and bending.

– As the level of jambul seed powder increased from 6 to 10 per cent, the hardness of the biscuit reduced and vice versa.

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