



ISSN (E): 2277- 7695

ISSN (P): 2349-8242

NAAS Rating: 5.03

TPI 2020; 9(9): 547-551

© 2020 TPI

www.thepharmajournal.com

Received: 13-07-2020

Accepted: 15-08-2020

SB Jadhav

Assistant Professor, College of
Agriculture, Ambajogai,
Maharashtra, India

SU Khodke

Head, Dept. of Agril. Process
Engineering, CAE & T,
VNMKV, Parbhani,
Maharashtra, India

Effect of varying pressing pressure and pressing time on textural qualities of soypaneer

SB Jadhav and SU Khodke

Abstract

The experiment was conducted at the department of Agricultural Process Engineering, CAE & T, VNMKV, Parbhani (Maharashtra) to study the effect of varying pressing pressure and pressing time on textural qualities of soypaneer. Soypaneer was prepared using 0.2% citric acid as a coagulant. Four levels of pressing pressure (1, 2, 3, 4 bar) and three levels of pressing time (15, 20, 25 min) were taken and soypaneer samples were prepared. The textural properties (Hardness, Cohesiveness, Springiness, Gumminess, Chewiness and Adhesiveness) of soypaneer samples were evaluated using texture analyzer (TA. XT. Plus Texture Analyzer, Stable Micro System, UK). The study indicated that all the textural properties of soypaneer were found to increase with increase in pressing pressure and pressing time. The pressing pressure of 3 bar and pressing time of 25 min were found to get desired hardness of soypaneer.

Keywords: Soypaneer, coagulant, hardness

Introduction

Soypaneer is one of the nutritional products which can be prepared from soymilk. It is a soft cheese-like food made by curdling soymilk with a coagulant (Jeelani *et al.*, 2014). Soypaneer is known for its extraordinary nutritional benefits as well as its versatility. Soypaneer has been reported as low calorie food and rich source of iron, isoflavones, calcium and low fat. Soypaneer contains 15% protein, 3.6% fat, 72% moisture, 1.9% carbohydrate, 0.4% fibre, 12.0 (mg) calcium, 8.6 (mg) phosphorous, 0.02 (mg) vitamin B1 and 0.03 (mg) vitamin B2 (Jha and Gandhi, 1987) [3].

Soypaneer preparation generally includes soaking soybean in water, simultaneous grinding and cooking of soaked soybean, deodorizing, filtering soymilk from okara, coagulation of soymilk at 80 °C temperature of soymilk, filtering coagulated solids from whey, molding and pressing of solids. As the quality of soypaneer depends upon its texture, there is a lot of scope to study the effect of various parameters viz. soaking time, grinding time, type of coagulant, concentration of coagulant, pressing pressure, pressing time, etc. The textural properties of soypaneer are highly affected by the pressing pressure and pressing time used during preparation of soypaneer. Soypaneer should preferably have optimum firmness so that it permits easy cutting and slicing and yet is tender enough not to resist crushing during mastication. For achieving this particular type of texture, there is a need to standardize pressing pressure applied over the soybean curd and pressing time during preparation of soypaneer.

Materials and Methods

Procurement of Soybean

Well graded soybean (JS-335) was procured from Seed Processing Plant, VNMKV, Parbhani (Maharashtra). The soybean grains were manually cleaned to remove foreign matter, dust, dirt, brokens and immature grains. Soybean was dehulled and soyadal was prepared in a dehuller.

Preparation of Soypaneer

Soymilk plant (Model: SC-20) was used for preparation of soymilk. 2 kg clean soyadal was soaked in water in the ratio of 1:3 (w/v) for 4 h. After soaking, the soaked water was decanted and the soyadal was washed manually by using clean water and the water was drained. Washed soyadal was ground with 12 lit water in the ratio of 1:6 (w/v) in the grinder. The ground slurry was boiled at 115 °C at 19 psi pressure (1.33 kg/cm²) by passing steam from the boiler into the grinder for 15-20 min. The cooked slurry was again stirred for 30 sec in the grinder. The slurry was released slowly from the grinder to the flashing chamber by switching

Corresponding Author:

SB Jadhav

Assistant Professor, College of
Agriculture, Ambajogai,
Maharashtra, India

on the vacuum pump and creating 280 to 300 mm of Hg vacuum inside the flashing chamber. The water flow of 2 lit/min was ensured at the vacuum pump. The water supply and power supply was closed when the pressure inside the grinder became zero. The slurry was drained from the flashing chamber to a filter press. The soymilk was squeezed and taken out through the outlet of filter press and the okara was retrieved from the filter bag of filter press. The soymilk was then coagulated at 80 °C with citric acid as coagulant (0.2%). The coagulated mixture was left undisturbed for about 15 minutes. The coagulum was filtered with a muslin cloth and whey was separated from the solid. The solid was gently transferred and pressed in a pneumatic paneer press.

The effect of pressing pressure and pressing time was studied as these parameters affect the removal of whey from the soypaneer which in turn affects textural properties of soypaneer. Four levels of pressing pressure (1, 2, 3, 4 bar) and three levels of pressing time (15, 20, 25 min) were decided and soypaneer samples were prepared. The textural properties (Hardness, Cohesiveness, Springiness, Gumminess, Chewiness and Adhesiveness) of soypaneer samples were evaluated using texture analyzer (TA. XT. Plus Texture Analyzer, Stable Micro System, UK). Ten replicate tests were carried out for each type of soypaneer. The typical textural

profile curve (force-time curve) given by texture analyzer for each sample was used to determine the textural properties of soypaneer.

Results and Discussion

Hardness

Measured values of hardness of soypaneer prepared by varying pressing pressure and pressing time are tabulated in Table 1. Table 1 reveals that the hardness values of prepared soypaneer increased with increase in pressing pressure and pressing time. The maximum hardness value (201.15 g) of soypaneer was observed when pressed at 4 bar pressure for 25 min followed by the hardness value (193.25 g) of soypaneer pressed at 4 bar pressure for 20 min. Table 1 also shows that minimum hardness value (34.84 g) was observed in soypaneer when it was pressed at 1 bar pressure for 15 min. The variation in the hardness values of soypaneer may be due to variation in amount of whey drained from the soypaneer at different pressing pressure and pressing time.

It is also observed from analysis of variance that the hardness value of soypaneer was significantly influenced by pressing pressure and pressing time and their interaction effect was also found to be significant.

Table 1: Effect of pressing pressure and pressing time on hardness (g) of soypaneer

Pressing pressure (bar)	Pressing time (min)			
	15	20	25	
1	34.84	44.72	50.64	
2	58.61	66.57	76.75	
3	82.11	121.81	151.96	
4	171.87	193.25	201.15	
Analysis of variance				
Source of variation	MSS	F-value	S.E.	C.D.
Pressing Pressure (P)	37,245.161	37,217.768	0.333	0.979*
Pressing Time (T)	3,358.552	3,356.081	0.289	0.848*
P x T	483.703	483.347	0.578	1.696*

* 5% level of significance ^{NS} Non significant

Fig.1 exhibits the linear increasing trend in hardness values of soypaneer when pressing pressure was increased from 1 to 4 bar and pressing time was increased from 15 to 25 min. Gandhi and Bourne (1988) [2] observed the similar trend of linear increase in hardness value of soypaneer with increase in

pressing pressure and pressing time. The similar observations of linear increasing trend in hardness value of soypaneer with increase in pressing pressure and pressing time were also noted by Murdia (2010) [4].

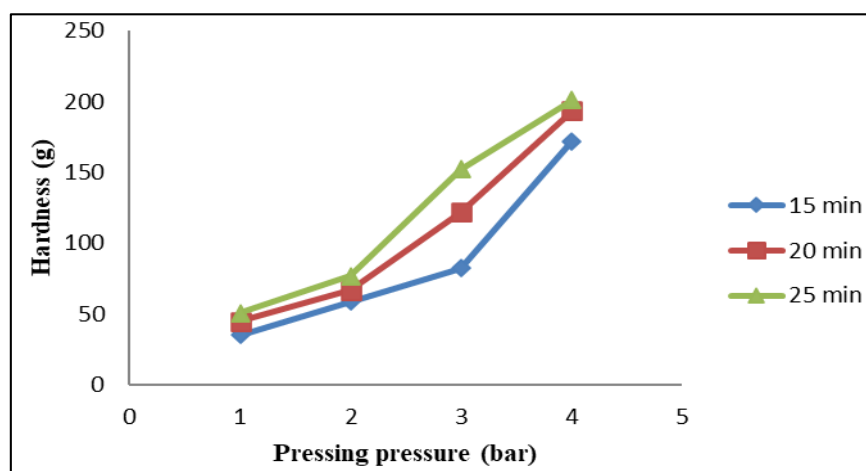


Fig 1: Effect of pressing pressure and pressing time on hardness of soypaneer

The hardness of commercially accepted milk paneer was determined by Texture Analyzer (TA. XT. Plus Texture

Analyzer, Stable Micro System, UK) available at the department of Agricultural Process Engineering and

Technology, VNMKV, Parbhani. It was found to be 153.76 g. The value of soypaneer hardness (151.96 g) observed in treatment combination of 3 bar pressing pressure and 25 min pressing time which was found close to the hardness value of milk paneer (153.76 g) and hence considered as optimum value of hardness for soypaneer.

The following multiple regression equation ($R^2 = 0.936$) showed that pressing pressure (X_1) and pressing time (X_2) had significant effect on hardness of soypaneer. However, hardness of soypaneer was more affected by pressing pressure than pressing time.

$$H = 48.739X_1 + 3.327X_2 - 66.841$$

Where, H is the hardness in g, X_1 is the pressing pressure in bar and X_2 is the pressing time in min.

Gumminess

Computed values of gumminess of soypaneer prepared by varying pressing pressure and pressing time are tabulated in Table 2. From Table 2, it is revealed that the gumminess values of prepared soypaneer increased with increase in pressing pressure and pressing time. The maximum gumminess value (135.98 g) of soypaneer was observed when pressed at 4 bar pressure for 25 min followed by the gumminess value (130.06 g) of soypaneer pressed at 4 bar pressure for 20 min. Table 2 also reveals that minimum gumminess value (17.49 g) was observed in soypaneer when it was pressed at 1 bar pressure for 15 min. Higher values of

gumminess of soypaneer indicate higher values of hardness and cohesiveness.

Table 2: Effect of pressing pressure and pressing time on gumminess (g) of soypaneer

Pressing pressure (bar)	Pressing time (min)			
	15	20	25	
1 bar	17.49	23.34	27.40	
2 bar	32.06	36.75	44.21	
3 bar	47.71	73.70	101.05	
4 bar	115.32	130.06	135.98	
Analysis of variance				
Source of variation	MSS	F-value	S.E.	C.D.
Pressing Pressure (P)	19,435.898	19,439.378	0.333	0.979*
Pressing Time (T)	1,758.627	1,758.942	0.289	0.848*
P x T	320.599	320.657	0.577	1.695*

* 5% level of significance ^{NS} Non significant

It is also observed from analysis of variance that the gumminess values of soypaneer were significantly influenced by pressing pressure and pressing time. The interaction effect of pressing pressure and pressing time was also found to be significant.

Fig.2 shows linear increasing trend in gumminess values of soypaneer when pressing pressure was increased from 1 to 4 bar and pressing time was increased from 15 to 25 min. As the gumminess is the product of hardness and cohesiveness it showed the similar trend as that of hardness of soypaneer.

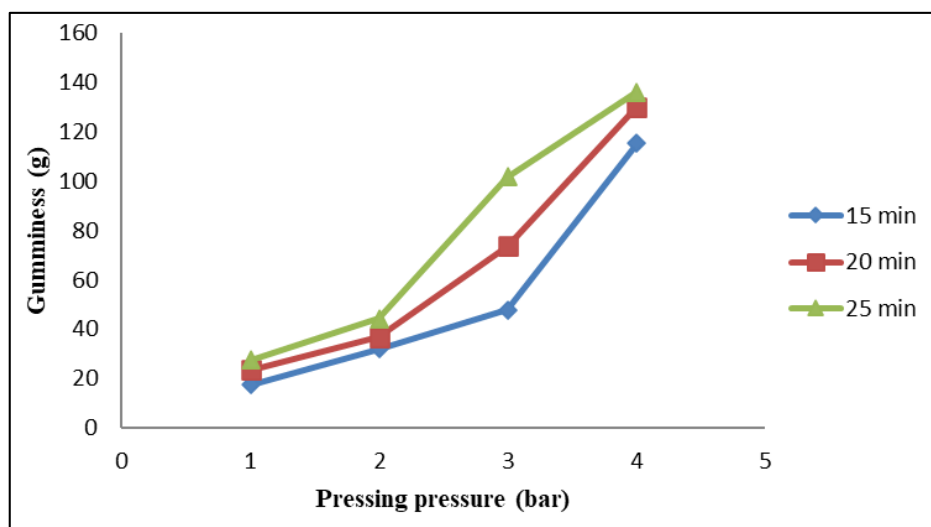


Fig 2: Effect of pressing pressure and pressing time on gumminess of soypaneer

The following multiple regression equation ($R^2 = 0.919$) showed that pressing pressure (X_1) and pressing time (X_2) had significant effect on gumminess of soypaneer. However, gumminess of soypaneer was more affected by pressing pressure than pressing time.

$$G = 34.985X_1 + 2.420X_2 - 56.555$$

where G is the hardness in g, X_1 is the pressing pressure in bar and X_2 is the pressing time in min.

Chewiness

Chewiness is the product of hardness, cohesiveness and springiness and refers to the energy required to masticate the food material to make it ready for swallowing. Computed

values of chewiness of soypaneer prepared by varying pressing pressure and pressing time are tabulated in Table 3. Table 3 shows that the chewiness values of prepared soypaneer increased with increase in pressing pressure and pressing time. The maximum chewiness value (135.86 g) was observed in soypaneer pressed at 4 bar pressure for 25 min followed by the chewiness value (129.94 g) of soypaneer pressed at 4 bar pressure for 20 min. It is also observed from Table 3 that the minimum chewiness value (17.43 g) was noted in soypaneer when it was pressed at 1 bar pressure for 15 min. Higher values of chewiness of soypaneer indicate higher values of hardness and cohesiveness. Murdia (2010) ^[4] reported the correlation of chewiness of soypaneer with the hardness of soypaneer.

Table 3: Effect of pressing pressure and pressing time on chewiness (g) of soypaneer

Pressing pressure (bar)	Pressing time (min)			
	15	20	25	
1 bar	17.43	23.26	27.30	
2 bar	31.95	36.65	44.09	
3 bar	47.58	73.63	100.78	
4 bar	115.22	129.94	135.86	
Analysis of variance				
Source of variation	MSS	F-value	S.E.	C.D.
Pressing Pressure (P)	19,414.795	19,418.716	0.333	0.979*
Pressing Time (T)	1,731.774	1,732.123	0.289	0.848*
P x T	310.281	310.343	0.577	1.695*

* 5% level of significance ^{NS} Non significant

Analysis of variance indicates that the chewiness values of soypaneer were significantly influenced by pressing pressure and pressing time. The chewiness values were also significantly influenced by the interaction effect of pressing pressure and pressing time.

It is observed from Fig.3 that the chewiness values of soypaneer were increased linearly when pressing pressure was increased from 1 to 4 bar and pressing time was increased from 15 to 25 min.

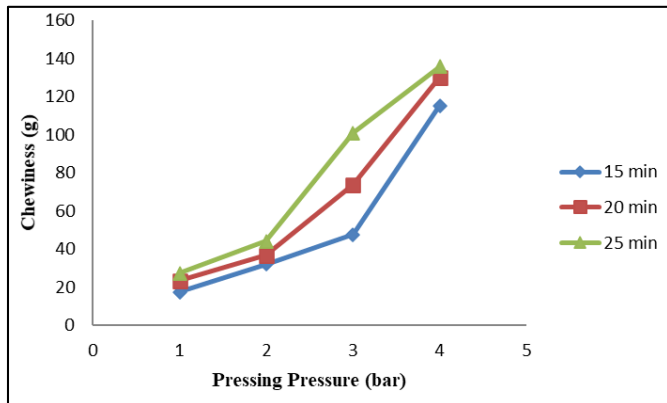


Fig 3: Effect of pressing pressure and pressing time on chewiness of soypaneer

The following multiple regression equation was fitted with an R² value of 0.919.

$$C_w = 34.952X_1 + 2.401X_2 - 56.28$$

where C_w is the chewiness, X₁ is the pressing pressure in bar and X₂ is the pressing time in min.

The equation showed that pressing pressure (X₁) and pressing time (X₂) had significant effect on chewiness of soypaneer. However, chewiness of soypaneer was more affected by pressing pressure than pressing time.

Cohesiveness

The cohesiveness values of soypaneer were computed and presented in Table 4. It is revealed from the Table 4 that the cohesiveness values of prepared soypaneer increased with increase in pressing pressure and pressing time. The maximum cohesiveness value (0.676) was observed in soypaneer pressed at 4 bar pressure for 25 min followed by the chewiness value (0.673) of soypaneer pressed at 4 bar pressure for 20 min. Table 4 also shows that minimum cohesiveness value (0.502) was observed in soypaneer when it was pressed at 1 bar pressure for 15 min. The cohesiveness

values of soypaneer were found to be increased when pressing pressure was increased from 1 to 4 bar and pressing time was increased from 15 to 25 min during its preparation. Soypaneer with higher values of cohesiveness indicates higher internal bonding of the soypaneer.

Table 4: Effect of pressing pressure and pressing time on cohesiveness of soypaneer

Pressing pressure (bar)	Pressing time (min)			
	15	20	25	
1 bar	0.502	0.522	0.541	
2 bar	0.547	0.552	0.576	
3 bar	0.581	0.605	0.665	
4 bar	0.671	0.673	0.676	
Analysis of variance				
Source of variation	MSS	F-value	S.E.	C.D.
Pressing Pressure (P)	0.040	15.517	0.017	0.050*
Pressing Time (T)	0.005	1.868 ^{NS}	0.015	N.S.
P x T	0.001	0.348 ^{NS}	0.029	N.S.

* 5% level of significance ^{NS} Non significant

The analysis of variance was carried out to study the effect of pressing pressure and pressing time on cohesiveness values of soypaneer. It indicates that the cohesiveness values of soypaneer were significantly influenced by pressing pressure. However, the cohesiveness values of soypaneer were not significantly influenced by pressing time. The interaction effect of pressing pressure and pressing time on cohesiveness values of soypaneer was also found to be nonsignificant.

Springiness

The springiness values of soypaneer were computed and presented in Table 5. It is revealed from the Table 5 that the springiness values of soypaneer varied from 0.9965 to 0.9991. An analysis of variance was carried out to study the effect of pressing pressure and pressing time on the springiness of soypaneer and presented in Table 5. It shows that the springiness values of prepared soypaneer were not significantly affected by the pressing pressure and pressing time. The interaction effect of pressing pressure and pressing time on springiness values of soypaneer was also found to be nonsignificant.

Table 5: Effect of pressing pressure and pressing time on springiness of soypaneer

Pressing pressure (bar)	Pressing time (min)			
	15	20	25	
1 bar	0.9965	0.9965	0.9965	
2 bar	0.9965	0.9973	0.9973	
3 bar	0.9973	0.9973	0.9973	
4 bar	0.9991	0.9991	0.9991	
Analysis of variance				
Source of variation	MSS	F-value	S.E.	C.D.
Pressing Pressure (P)	0.000	0.148	0.003	N.S.
Pressing Time (T)	0.000	0.061	0.003	N.S.
P x T	0.000	0.007	0.006	N.S.

* 5% level of significance ^{NS} Non significant

Adhesiveness

The adhesiveness values of soypaneer are tabulated in Table 6. The values of adhesiveness of prepared soypaneer varied from -0.121 to -0.182. An ANOVA was carried out to study the effect of pressing pressure and pressing time on the adhesiveness of soypaneer. It is revealed from the Table 6 that the adhesiveness values of prepared soypaneer were not

significantly affected by the pressing pressure and pressing time. The interaction effect of pressing pressure and pressing time on adhesiveness values of soypaneer was also found to be nonsignificant.

Table 6: Effect of pressing pressure and pressing time on adhesiveness of soypaneer

Pressing pressure (bar)	Pressing time (min)			
	15	20	25	
1 bar	-0.182	-0.179	-0.175	
2 bar	-0.171	-0.164	-0.159	
3 bar	-0.151	-0.142	-0.140	
4 bar	-0.133	-0.124	-0.121	
Analysis of variance				
Source of variation	MSS	F-value	S.E.	C.D.
Pressing Pressure (P)	0.005	0.481	0.033	N.S.
Pressing Time (T)	0.000	0.036 ^{NS}	0.029	N.S.
P x T	0.000	0.001 ^{NS}	0.058	N.S.

* 5% level of significance ^{NS} Non significant

Conclusions

All the textural properties of soypaneer viz. hardness, gumminess, chewiness, cohesiveness, springiness and adhesiveness were found to increase with increase in pressing pressure and pressing time. The textural properties of soypaneer viz. hardness, gumminess and chewiness were significantly influenced by pressing pressure and pressing time. The interaction effect of pressing pressure and pressing time was also found to be significant. The cohesiveness values of soypaneer were significantly influenced by pressing pressure. However, the cohesiveness values of soypaneer were not significantly influenced by pressing time. The interaction effect of pressing pressure and pressing time on cohesiveness values of soypaneer was also found to be nonsignificant. The springiness and adhesiveness values of prepared soypaneer were not significantly affected by the pressing pressure and pressing time. The interaction effect of pressing pressure and pressing time on springiness values of soypaneer was also found to be nonsignificant. The pressing pressure of 3 bar and pressing time of 25 min were found to get desired hardness of soypaneer.

References

1. Beddows CG, Wong J. Optimization of yield and properties of silken tofu from Soybeans. III. Coagulant concentration, mixing and filtration pressure. *International Journal of Food Science and Technology*. 1987; (22):29-34.
2. Gandhi AP, Bourne MC. Effect of pressure and storage time on texture profile parameters of soybean curd (tofu). *Journal of Texture Studies*. 1988; 19:137-142.
3. Jha, Gandhi. Preparation of soypaneer at rural level. *Indian Journal of Nutrition Diet*. 1987, 24-45.
4. Murdia LK, Wadhwani R. Effect of processing parameters on texture and yield of tofu. *Asian Journal Food and Agro-Industry*. 2010; 3(2):232-24.
5. Rekha CR, Vijayalakshmi G. Influence of processing parameters on the quality of soycurd (tofu). *Journal of Food Science and Technology*. 2013; 50(1):176-180.
6. Swati S. Optimization of process parameters for production of soypaneer. (Master's Thesis). Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (MP), 2015.