Preparation and study the physical properties of snacks product Chakli by incorporation of gaur gum and gum Arabic

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In this study used of gaur gum and gum arabic in different amounts as independent variables were produced 13 different combinations, two variables, five levels. The purpose of this study was the effect of gaur gum and gum arabic on physical properties of chakli sample using response surface methodology. Multiple regression equations were obtained to describe the effects of each variable on product responses. From this study it was concluded that, optimum solution by numerical optimization for chakli content gaur gum content 1.45 g, gum arabic content 1.82 g and optimized condition for deep fat fried snacks chakli given best snacks product with positive results that increased in water solubility index and lateral expansion while negative effect on moisture content, shearing force and hygroscopicity.

Key Words : Gaur gum, Gum arabic, Water solubility index, Lateral expansion, Moisture content, Shearing force, Hygroscopicity

INTRODUCTION

The chakli is Indian traditional foods which are mainly use for snacks those are mainly prepared by using chickpea flour. These are fried savory resembling of vermicelli or noodles. It was almost popularly fried snacks item consumed quiet frequent all over country. These contain more oil constituting in 40 to 45 per cent of total products (Pinthus *et al.,* 1993). Pulses are containing proteins with amino acids with low Sulphur and rich in lysine, respectively. Blumenthal (1991) showed that in animal diets chickpeas are great source of protein and high energy as equivalent to the egg, meat and milk production. Furthermore some secondary compounds like chymotrypsin and trypsin inhibitors are contained in chickpeas that negatively affect the nutrients utilization by non-ruminants. Gram flour in India is commonly called as Besan. It can be produced through fine grinding of chickpeas. This type of flour was used for preparing several fried snacks and side dishes. The besan colour differs from dark yellow to light yellowish. *Urad dal* is

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somewhat black in colour and white interior in side; it is very small in size and shape. It is earthy flavour and sticky (mucous) in nature after the boiling. The most popular verity of *Urad dal* is dal makhani in Punjab and *Urad papad* also prepared in several parts of India. *Urad dal* is available in all over the region of the India and it is consumption is major in the north region. *Urad dal* is improving the digestibility of digestive system. The hydrocolloids were hydrophilic polymers of creature vegetable, microbial or manufactured starting point that for the most part contain a lot more hydroxyl gatherings and might be polyelectrolyte. The best model like alginate, carboxy methyl cellulose (CMC), carragenan, gum arabic, gelatin and thickener etc. Hence, all hydrocolloids were utilized completely or somewhat dissolvable in water particles and are utilized chiefly to builds the thickness of the consistent stage like watery phase *i.e.* as gelling specialist or thickener (Skurtys *et al.*, 1999). The sufficient admission of guar gum in the form of fibre helps in the bowel consistency support huge decreases in total as well as LDL cholesterol, diabetes control improvement of mineral ingestion and avoidance of problems of digestives like clogging, respectively (Yoon *et al.*, 2008).

The objective of this study to investigate the physical properties of the snacks chakli sample that increases in water absorption index and water solubility index and lateral expansion negative effect on moisture content, shearing force and hygroscopicity.

METHODOLOGY

To prepare low fat namkeen, Chickpea flour (CF) (Besan) and Black gram flour (BGF) was added in different proportions. Two hydrocolloids are used individually namely guar gum and gum arabic.
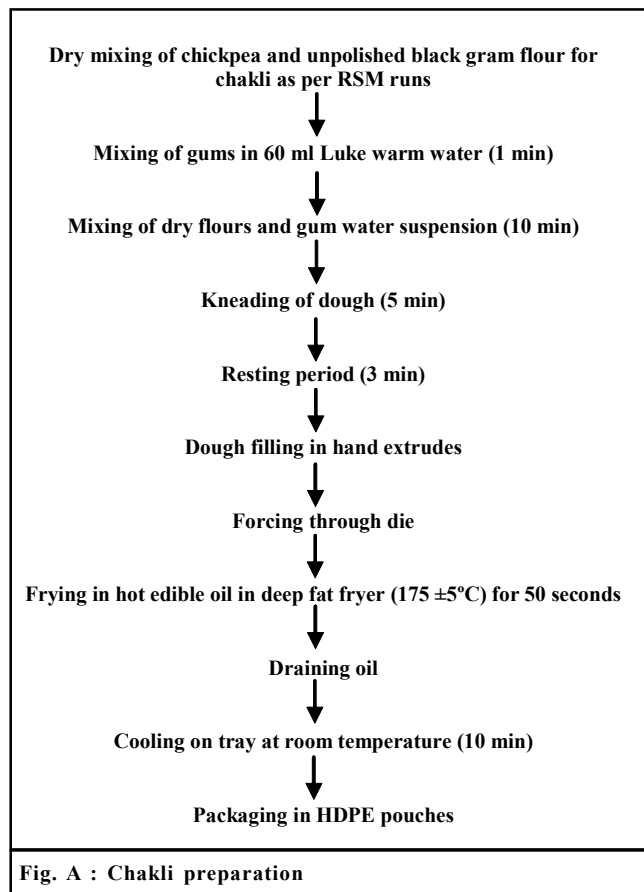
The research is carried based on rotatable experimental response of design of RSM: Response Surface Methodology.

Raw Materials

Raw material used for chakli: Chickpea flour, Unpolished black gram,

Gaur gum (1, 1.5, 2.0, 2.5, 3.0 %), Gum Arabic (0.5, 1.0, 1.5, 2.0, 2.5 %)

The method of preparation of snacks product as fallowed:

Dry mixing of chickpea and unpolished black gram flour for chakli as per RSM runs

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Mixing of gums in 60 ml Luke warm water (1 min)

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Mixing of dry flours and gum water suspension (10 min)

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Kneading of dough (5 min)

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Resting period (3 min)

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Dough filling in hand extrudes

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Forcing through die

↓

Frying in hot edible oil in deep fat fryer (175 ±5ºC) for 50 seconds

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Draining oil

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Cooling on tray at room temperature (10 min)

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Packaging in HDPE pouches

Fig. A : Chakli preparation

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Water solubility index (WSI):

A design summary of water solubility index minimum and maximum ranged from 0.30 to 0.89 per cent. The statistical values of WSI as well as other model co-efficients were presented in the Table 1. The Regression model used for estimating the results from the experiment the Model F value on 29.57 was significant. The Lack of Fit F value 1.01 was not significant (P > 0.05) relative to pure error. The lack of a non-significant value was also better forth fit model. The fit of model was articulated by the co-efficient of determination R^2 that has been observed as 0.9548 the Adj.R^2 was 0.9225 and the adequate Precision has been 18.003 shown a tolerable signal. The considering all criteria stated above a model given in eq. 1 has been stated to represent any difference in water

Table 1 : ANOVA for WSI of snacks product (Chakli)

Factor	DF	Sum of squares	Mean square	F value	Prob > F
Model	5	0.32	0.065	29.57	<0.0001"
A	1	2.175E-004	2.175E-004	0.100	0.7615
B	1	0.23	0.23	103.99	<0.0001
A^2	1	0.030	0.030	13.88	0.0074
B^2	1	0.052	0.052	23.84	0.0018
AB	1	1.225E-003	1.225E-003	0.56	0.4783
Lack of fit	3	6.606E-003	2.202E-003	1.01	0.4739
Pure error	4	8.680E-003	2.170E-003		
Residual	7	0.015	2.184E-003		
Total	12	0.34			
R^2 0.9548,	Adj. R^2 0.9225,		Adeq. Press. 18.003		

solubility index.

W.S.I. (Chakli) = +0.75 -0.05214*A +0.17*B+0.666*A²– 0.086B² +0.018*A*B .....(Eq. 1)

where A and B are the coded variable for gaur gum and gum arabic, respectively. Above eq. (1) Showed that the co-efficient of A and B was negative and positive. Data from Table 1 indicated that WSI of gaur gum and gum arabic gave significant model (P<0.05). In linear term gaur gum (A) and gum arabic (B) were established to be significant (P<0.05). Fvalue for linear terms gaur gum (A) and gum arabic (B) were 0.100 and 103.99 and P value was found to be 0.7616 and 0.0001 (P<0.05), respectively (Table 1). Quadratic terms of gaur gum (A) and gum arabic (B) had been observed significant (P<0.05). F value for quadratic terms gaur gum (A^2) and gum arabic (B^2) are 13.88 and 23.84 and P value has been to be 0.0074 and 0.0018 (P<0.05) shown significant effect, respectively. The interaction term form gaur gum and gum arabic (AB) gave non-significant effect P value

WSI
A : Gaur Gum
B : Gum Arabic

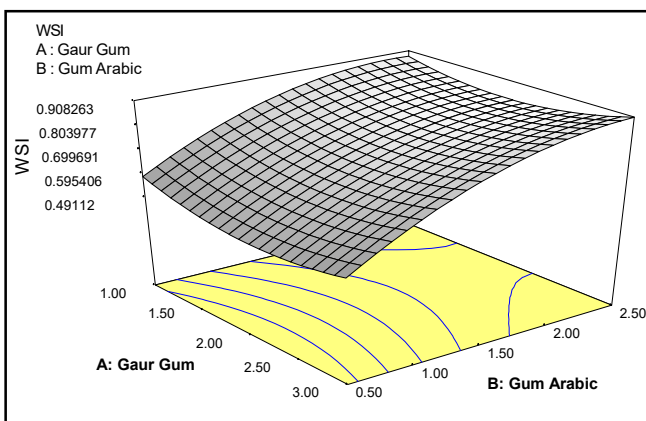**Fig. 1 : Response plot for WSI of snacks product chakli**

was found to be 0.4739 (P<0.05) also it showed adverse impacts on the interaction term as well as F value found to be 0.56. Fig. 1 showed the effect of gaur gum (A) and gum arabic (B) on WSI of snacks product. As, gaur gum content increases water solubility index decreases and gum arabic content increases water solubility index increases.

Moisture content (MC):

The moisture content is most important parameter to found out the moisture content in any food item. The moisture content directly affects the quality of products and products acceptance by consumers. Design summary of moisture content minimum and maximum ranged between 2 to 6 per cent. The MC statistical attributes as well as the used pertained co-efficients of the model are pertained in Table 2. The experimental outcomes were calculated using the regression model depicting that the significance of the Model Fvalue was at 10.90. The Lack of Fit F value 0.11 was not significant (P>0.05) normally relative to pure error. This absence of a non-significant value was good for the model to fit. This model to fit has been also stated by the determination co-efficient R^2 which was observed to be 0.8735 the Adj.R^2 were 0.7832 where the Adequate Precision was 11.877 shown an adequate signal. The making an allowance for every mentioned criterion a model shown in Eq. 2 has been chosen for representing a variation of Moisture content.

M.C. (Chakli) = +3.00 +0.00*A -0.85*B +1.00*A² +0.000*B² -1.00*A*B … (Eq. 2)

where A and B are the coded variable for gaur gum and gum arabic, respectively. Above eq. (2) Showed that

Table 2 : ANOVA for MC of snacks product (Chakli)

Factor	DF	Sum of squares	Mean square	F value	Prob > F
Model"	5	16.91	3.38	10.90	0.0034
A	1	0.000	0.000	0.000	1.0000
B	1	5.83	5.53	18.79	0.0034
A^2	1	6.96	6.96	22.42	0.0021
B^2	1	0.000	0.000	0.000	1.0000
AB	1	4.00	4.00	12.89	0.0088
Lack of fit	3	0.17	0.057	0.11	0.9471
Pure error	4	2.00	0.50		
Residual	7	2.17	0.31		
Total	12	19.08			
R^2 0.8735,		Adj.R^2 0.7832,		Adeq. Press. 11.877	

the co-efficient of A and B was positive and negative. Data from Table 2 indicated that MC of gaur gum and gum arabic gave significant model (P<0.05). In linear term, gaur gum (A) and gum arabic (B) are estimated as non-significant and significant (P<0.05). F value for linear terms gaur gum (A) and gum arabic (B) are 0.00 and 18.79 and P value has been observed to be 1.0000 and 0.0034 (P<0.05), respectively (Table 2). The quadratic terms of gaur gum (A) and gum Arabic (B) have been mentioned significant and non-significant (P<0.05). F value for quadratic terms gaur gum (A^2) and gum arabic (B^2) are 22.44 and 0.000 and P value has been pertained to be 0.0021 and 1.0000 (P<0.05) showed significant and non-significant effect. The interaction term form gaur gum and gum arabic (AB) gave significant effect P value was found to be 0.0088 (P<0.05) and it showed the negative effect on the interaction term and F value found to be 12.89. Fig. 2 showed the effect of gaur gum (A) and

gum arabic (B) on MC of snacks product. As, gaur gum content increases moisture content decreases first then increases and gum arabic content increases moisture content decreases.

Lateral expansion (L.E.):

The design summary of hardness, minimum and maximum ranged from 0.80 to 1.85 mm, respectively. The statistical L.E. attributes as well as the used pertained co-efficients of the model are pertained in Table 3. The experimental outcomes were calculated using the regression model depicting that the significance of the Model F value was at 22.30. The Lack of Fit F value 5.15 was not significant (P>0.05) relative to pure error. This absence of a non-significant value was good for the model of it. This model to fit has been also stated by the determination co-efficient R^2 which was observed to be 0.9409 the Adj. R^2 were 0.8987 where the Adequate Precision was 18.830 shown an adequate signal. The making an allowance for every mentioned criterion, a model shown in Eq. 3 has been chosen for representing a variation of hardness of selected products.

Lateral Expansion (Chakli) = +1.23 -0.093*A +0.10*B -0.15*A^2 +0.19*B^2 +0.013*A*B … (Eq. 3)

where A and B are the coded variable for gaur gum and gum arabic, respectively. Above eq. (3) Showed that the co-efficient of A and B was negative and positive. Data from Table 3 indicated that L.E. of gaur gum and gum arabic gave significant model (P<0.05). In linear term gaur gum (A) and gum arabic (B) were found to be significant (P<0.05). F value for linear terms gaur gum (A) and gum arabic (B) were 12.49 and 14.46 and P value was found to be 0.0095 and 0.0067 (P<0.05),

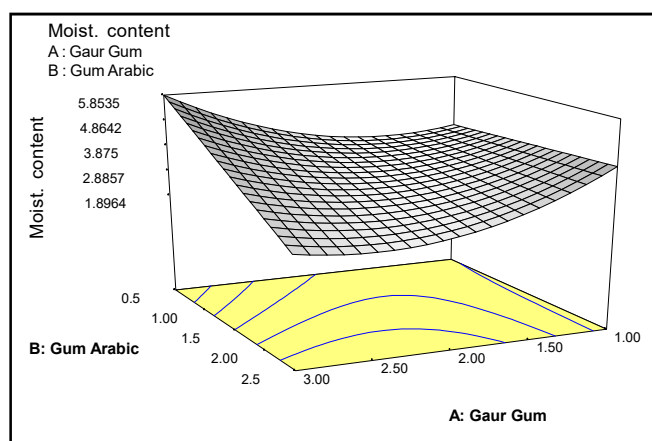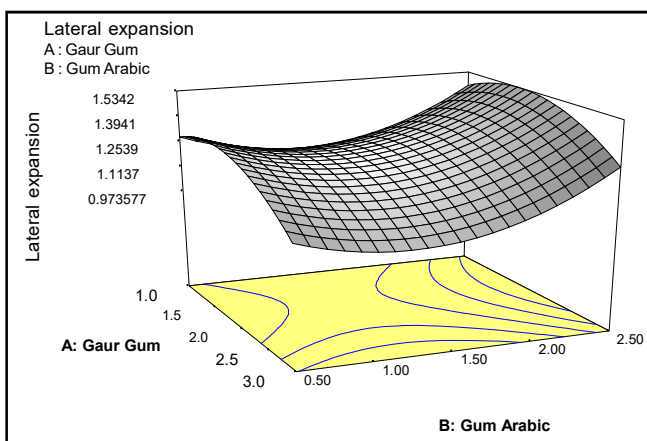**Fig. 2 : Response plot for MC of snacks product chakli**

Table 3 : ANOVA for LE of snacks products (Chakli)

Factor	DF	Sum of squares	Mean square	F value	Prob > F
Model	5	0.62	0.12	22.30	0.0004
A	1	0.069	0.069	12.49	0.0095
B	1	0.080	0.080	14.46	0.0067
A^2	1	0.15	0.15	27.02	0.0013
B^2	1	0.26	0.26	46.71	0.0002
AB	1	6.250E004	6.250E004	0.11	0.7471
Lack of fit	3	0.031	0.010	5.15	0.0737
Pure error	4	8.000E003	2.000E003		
Residual	7	0.039	5.554E003		
Total	12	0.66			
R^2 0.9409,	Adj. R^2 0.8987,		Adeq. Press. 18.830		

respectively (Table 3). Quadratic terms of gaur gum (A) and gum arabic (B) had shown significant (P<0.05). F value for quadratic terms gaur gum(A^2) and gum aerabic (B^2) were 27.02 and 46.71 and P value was found to be 0.0013 and 0.0002 (P<0.05) showed significant effect, respectively. The interaction term form gaur gum and gum arabic (AB) given nonsignificant effect P value was observed to be 0.7411 (P>0.05) and it shown the positive effect on the interaction term and F value observed to be 0.11. Fig. 3 showed the effect of gaur gum (A) and gum arabic (B) on L.E. of snacks product. As, gaur gum content increases lateral expansion decreases and gum arabic content increases lateral expansion increases simultaneously.

Shearing force:

Design summary of shearing force, minimum and maximum ranged from 67.63 to 78.18 kg. sec. The

Fig. 3 : Response plot for lateral expansion of snacks product chakli

statistical shearing forces attributes as well as the used pertained co-efficients of the model are pertained in Table 4. The experimental outcomes were calculated using the regression model depicting that the significance of the Model F value was at 11.25. The Lack of Fit F value 0.20 was not significant (P>0.05) relative to pure error. This absence of a non-significant value was good for the model to fit. This model to fit has been also stated by the determination co-efficient R^2 which was observed to be 0.8893 the Adj. R^2 were 0.8103 where the Adequate Precision was 12.754 shown an adequate signal. The making an allowance for every mentioned criterion, a model shown in Eq. 4 has been chosen for representing a variation of shearing forces of research.

Shearing Force (Chakli) = +72.85 -0.89*A -2.52*B -1.18*A^2 +0.75*B^2 -1.66*A*B … (Eq. 4)

where A and B are the coded variable for gaur gum and gum arabic, respectively. Above eq. (4) showed that the co-efficient of A and B was negative. Data from Table 4 indicated that shearing force of gaur gum and gum arabic gave significant model (P<0.05). In linear term, gaur gum (A) and gum arabic (B) are observed were 4.27 and 34.19 and Pvalue are found to be 0.0777 and 0.0006 (P<0.05) (Table 4), respectively. Quadratic terms of gaur gum (A) and gum arabic (B) had shown significant (P<0.05). F value for quadratic terms gaur gum (A^2) and gum aerabic (B^2) were 6.47 and 2.65 and P value was found to be 0.0384 and 0.1476 (P<0.05) showed significant effect, respectively. The interaction term form gaur gum and gum arabic (AB) gave non-significant effect P value was found to be 0.0296 (P>0.05) and it showed the positive effect on the interaction term and F value found to be 7.48. Fig. 4 showed the effect of

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Table 4 : ANOVA for shearing force of snacks product (Chakli)

Factor	DF	Sum of squares	Mean square	F value	Prob > F
Model"	5	83.54	16.71	11.25	0.0031
A	1	6.34	6.43	4.27	0.0777
B	1	50.77	50.77	34.19	0.0006
A^2	1	9.61	9.61	6.47	0.0384
B^2	1	3.94	3.94	2.65	0.1476
AB	1	11.02	11.02	7.42	0.0296
Lack of fit	3	1.38	0.46	0.20	0.8884
Pure error	4	9.01	2.25		
Residual	7	10.40	1.49		
Total	12	93.94			
R^2 0.8893,		Adj. R^2 0.8103,		Adeq. Press. 12.754	

gaur gum (A) and gum arabic (B) on shearing force of snacks product. As, gaur gum content and gum arabic content increases shearing force decreases.
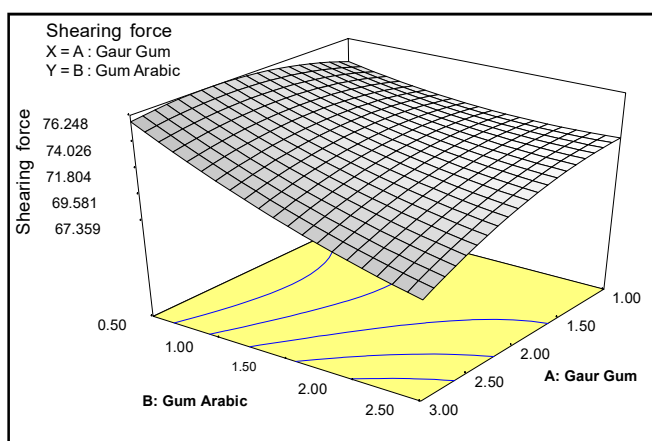
Hygroscopicity:

The design summary of hygroscopicity, minimum and maximum ranged from 5 to 13 g/100 g, respectively. The Table 5 showed the Model co-efficients and further statistical features of hygroscopicity. The regression models suited to experimental results are shown that Model F value of 11.88 was significant. The Lack of Fit F value 0.55 was not significant (P>0.05) relative to pure error. This absence of a non-significant value was good for the model to fit. This model to fit has been also stated by the determination co-efficient R^2 which was observed to be 0.8946 the Adj. R^2 were 0.8193 where the Adequate Precision was 10.207 shown an adequate signal. The making an allowance for every mentioned criterion, a

model shown in Eq. 5 has been chosen for representing a variation of shearing forces of research selected.

Hygroscopicity (Chakli) = +6.40 +0.30*A -0.13*B +0.80*A²
+1.55*B² -3.25*A*B ...(Eq. 5)

where A and B are the coded variable for gaur gum and gum arabic, respectively. Above eq. (5) showed that the co-efficient of A and B was positive and negative. Data from Table 5 indicated that hygroscopicity of gaur gum and gum arabic gave significant model (P<0.05). In linear term, gaur gum (A) and gum arabic (B) are observed to be significant (P<0.05). F value for linear terms gaur gum (A) and gum arabic (B) were 0.69 and 0.12 and P value was observed to be 0.4322 and 0.7401 (P<0.05), respectively (Table 4). Quadratic terms of gaur gum (A) and gum arabic (B) had shown significant (P<0.05). F value for quadratic terms gaur gum (A^2) and gum aerabic (B^2) were 4.24 and 15.92 and P value was found to be 0.0784 and 0.0053 (P<0.05) showed significant

Fig. 4 : Response plot for shearing force of snacks product chakli
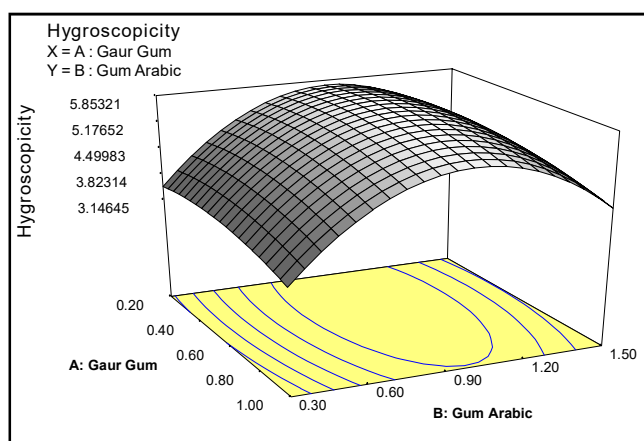
Fig. 5 : Response plot for hygroscopicity of snacks product chakli

Table 5 : ANOVA for hygroscopicity of snacks product (Chakli)

Factor	DF	Sum of squares	Mean square	F value	Prob > F
Model	5	63.35	12.47	11.88	0.0026
A	1	0.73	0.73	0.69	0.4322
B	1	0.13	0.13	0.12	0.7401
A^2	1	4.45	4.45	4.24	0.0784
B^2	1	16.71	16.71	15.92	0.0053
AB	1	42.25	42.25	40.26	0.0004
Lack of fit	3	2.15	0.72	0.55	0.6744
Pure error	4	5.20	1.30		
Residual	7	7.35	1.05		
Total	12	69.69			
	R^2 0.8946,		Adj. R^2 0.8193,	Adeq. Press. 10.207,	

effect, respectively. The interaction term form gaur gum and gum arabic (AB) gave non-significant effect P value was found to be 0.0004 (P>0.05) and it showed the positive effect on the interaction term and F value found to be 40.26. Fig. 5 showed the effect of gaur gum (A) and gum arabic (B) on hygroscopicity of snacks product. As, gaur gum content hygroscopicity increases and gum arabic content increases hygroscopicity decreases.

Conclusion:

From the above study it was concluded that there was preparation of good quality snack product like chakli along with the effect of gaur gum and gum arabic shows the results that increases in water solubility index and lateral expansion, negative effect on moisture content, shearing force and hygroscopicity.

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