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Development and preservation of a ready-to-eat cumin based appetizer with natural ingredients

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Spices such as ginger, pepper, cumin, chillies and many others are known for their stimulating effect and are used as active ingredients in appetizers formulations. A ready-to-eat (RTE) appetizer in the form of a chewy munch i.e. *jeera* munch has been developed by using Response Surface Methodology (RSM). The experimental design with active ingredients as variables and quality parameters such as acidity, acceptability score as the responses was used. Among the ingredients, raisins were pre-processed by frying in stable fat and cumin seeds were pulverized to a fine powder prior to the main processing. The optimized composition of ingredients was processed by concentration and dehydration. The product had the proximate composition of fat, 7.83; protein, 8.82 and carbohydrates 70.7%, respectively supplying about 77.7 Kcals per munch. The munches packed in metalized polyester pouches had a shelf-life of 9 months at 28±5°C as well as 37°C storage.

Keywords: Appetizer, Cumin, Jeera munch, Ready-to-eat (RTE) appetizer, Response Surface Methodology (RSM), Sensory score, Shelf-life.

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Introduction

Appetizers are one of the essential items yet to be included in the pack rations of Defence Forces at high altitudes. The exposure to high altitude is known to lead altitude sickness with different symptoms such as headache, nausea and vomiting. Subsequently loss of appetite and reduction in weight are the major problems faced at high altitudes[1,2].

Ginger is well known for its different functional properties benefiting the digestion and influencing the appetite. The ginger, cumin and lemon are also used traditionally for their antiemetic properties. The active compounds of ginger (gingerol and shaogol) and cumin seeds (cuminaldehyde) are responsible for their functional properties. Ginger is also used for treatment of asthma, shortness of breath, diarrhoea, nausea, motion sickness and appetite loss[3,4]. However, the holistic action will be from the whole spice and therefore cleaned spices are used in the present development. The lemon is a good source of vitamin C, which is required at higher level at altitudes. Ready-to-eat (RTE) products are preferred at high altitudes, which can avoid cooking, fuel use and energy required for preparation of dehydrated mixes. Regarding acceptance, Singh *et al* have reported the preference for sweet taste by the consumers at high altitude[5].

The optimization of the product in the present study has been achieved by statistical design software using Response Surface Methodology (RSM), which is the recent strategy widely applied for product development[6-10]. The study aims to provide shelf stable sweet and spicy appetizer with good acceptability.

Materials and Methods

Raw materials

Jaggery, cumin or *jeera* (*Cuminum cyminum* Linn.) powder, ginger (*Zingiber officinale* Rosc.) powder, raisins (*Vitis vinifera* Linn.), lemon [*Citrus limon* (Linn.) Burm.f.) and *ghee* (Nandini brand, Mysore) were procured from the local market. All the materials except *ghee* were cleaned prior to further use. The chemicals and reagents used for analysis were of AR grade.

Raw material processing

Lemons were washed in hot water, extracted the juice and filtered through 60-mesh sieve. The raisins were fried in ghee at 160-180°C for 30-50 sec and cooled thoroughly and were ground.

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Experimental design

A central composite rotatable design was used to set-up the experimental design. The numbers of design points were obtained based on the number of independent variables taken in the experimental design. The trial version of Design expert® version 8.0 statistical software package from Statease Inc. USA, was used to construct as well as to analyze the design. Ginger powder and *jeera* powder were taken as independent variable with sensory score and acidity as the responses. Since only two independent variables were involved the numbers of design points obtained were 13 including five centre point replications. The independent variables with their coded and actual values with ranges of levels are given in Table 1. The α-values in the design outside the ranges were selected for rotatability of the design[11]. The centre points were selected with ingredients at levels expected to yield satisfactory experimental results.

Appetizer processing

The required amounts of the ingredients were weighed as per the design to form different formulation batches. The appetizer was prepared by concentration and dehydration technique with continuous stirring while heating in an open pan at 160-200°C. In hot condition, the product was poured into trays pre-greased with ghee. After cooling, 20 g samples were weighed and hand moulded into oval shapes as individual munches, then packed in metalized polyester pouches (thickness= 45 µm) and stored at ambient conditions (18-33°C) and 37°C.

Analytical evaluation

The proximate analysis of munch was carried out by standard AOAC procedures[12]. The titrometric acidity and vitamin C content was determined by methods reported by Ranganna[13]. Changes in the TBA value during storage were estimated by spectroscopic method[14].

Sensory evaluation

All the combinations of the *jeera* munch were evaluated for their colour, aroma, taste, texture and overall acceptability on 5-point hedonic scale by semi-trained panel of 15 members during product development as well as storage studies.

Results and Discussion

A ready-to-eat (RTE) cumin based appetizer-*Jeera* munch, has been developed using RSM. The 13 experimental combinations of central composite rotatable design with two independent variables and two responses used in this study are given in Table 2. The use of sensory score and texture as responses for optimization of sweet potato based pasta product[7] and a statistical design with 2 variables with only overall acceptability (OAA) as the response for *rabri* powder optimization[10] have been reported. In another report, the OAA score and acidity have been used as responses in optimizing ginger based appetizer munches[9]. Since OAA is the most important criteria for acceptance of any product, it was taken as one response while the acidity was taken as another

Table 1—Experimental ranges and levels of independent variables used in RSM in terms of actual and coded factors

Variables	Range of levels					
	Actual	Coded	Actual	Coded	Actual	Coded
Jeera Munch						
a) Ginger powder	10	-1	15	0	20	+1
b) *Jeera* powder	8	-1	11.5	0	15	+1

Table 2—Design of experiments for *Jeera* Munch

Standard Order	Run Order	Ginger Powder (g)	*Jeera* Powder (g)	OAA* Score	Acidity (%)
10	1	15.00	11.50	3.31	1.29
1	2	10.00	08.00	3.00	1.14
11	3	15.00	11.50	3.38	1.32
9	4	15.00	11.50	3.10	1.34
5	5	07.93	11.50	2.70	1.00
6	6	22.07	11.50	3.05	1.51
13	7	15.00	11.50	3.30	1.32
2	8	20.00	08.00	3.05	1.48
12	9	15.00	11.50	3.50	1.22
8	10	15.00	16.45	2.80	1.22
7	11	15.00	06.55	3.12	1.40
4	12	20.00	15.00	3.10	1.42
3	13	10.00	15.00	2.60	1.07

*Overall acceptability on 5 - point Hedonic scale

response as the quality parameter. The ANOVA and the best fit polynomial models were obtained for both responses (Table 3), to assess how well the model represented the data. The Quadratic Model was fit for the overall acceptability response as the lack of fit was highly non-significant. The acidity response of the *jeera* munch was fit with Linear Model. Both models were fit using design expert software and were highly significant.

Table 3—ANOVA and Model statistics of the Appetizer

	Terms	Response	
		OAA[#] score	Acidity
1	Model	Quadratic	Linear
2	F-value	11.92	88.92
3	P>F	0.0026	0.0001
4	Mean	3.08	1.29
5	S.D.*	0.11	0.039
6	CV%	3.63	3.01
7	R squared	0.8949	0.9468
8	Adjusted R squared	0.8198	0.9361
9	Predicted R squared	0.8192	0.9172
10	Adequate precision	9.67	26.784

* Standard deviation
[#] Overall acceptability score

The response surface plots of the models fit to both responses have been plotted as a function of both variables used in the design. The effect of all the variations in levels of independent factors in the designs, on different responses is given in the perturbation graph for each response. The sensory score was equally influenced by the levels of *jeera* powder and ginger powder as represented in the perturbation graph, and further visualized in the 3D surface plot (Fig. 1). Another response i.e., acidity of the *jeera* munch was more influenced by ginger powder among the two variables (Fig. 2).

Multiple regression equations (in terms of coded factors) as obtained for OAA and acidity responses for the munch have been represented as follows:

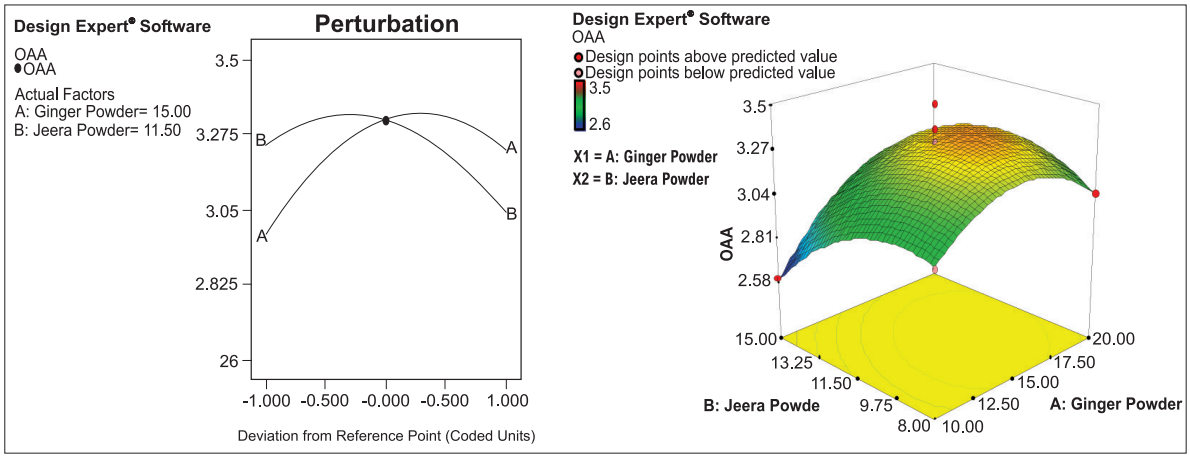

Fig. 1—Perturbation graph and 3D plot depicting effect of independent variables on Overall Acceptability (OAA) of *Jeera* Munch

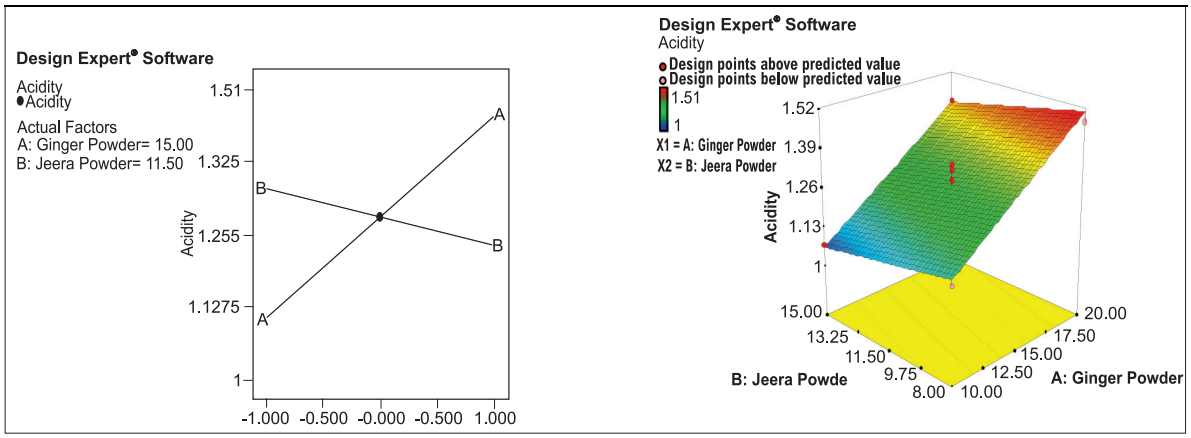

Fig. 2—Perturbation graph and 3D plot depicting effect of independent variables on Acidity of *Jeera* Munch

OAA of *Jeera* Munch (Y) = 3.32+ 0.13 * A 0.10*B + 0.11*A*B – 0.22*A^2 – 0.17*B^2

Acidity of *Jeera* Munch (Y) = 1.29 + 0.18*A – 0.048*B

Further, the optimization of the variable levels was achieved by desirable maximization of the necessary response along the fitted polynomial models by numerical optimization procedure of design expert software. The solutions were sought to maximize the desirability function for the given criteria by being at random starting points. The best among them with a suitable fit model was chosen as the optimized composition. The optimized levels of ginger powder and *jeera* powder were 16.24 and 10.77 g with predictions for acidity and OAA score as 3.34 and 1.34% and a desirability of 0.827. The desirability graph for optimized levels of the independent variables satisfying both responses has been represented in Fig. 3. The validation of the predictions was done by actual observations recorded for sensory score (3.4) and acidity (1.32). There was not much difference (P>0.05) in the actual observations; hence the model equations were highly suitable for predicting the responses. The *jeera* munch processed using the optimized ingredients composition was weighed and hand moulded into 20 g munches and was packed in metalized polyester pouches for storage. This RTE appetizer contains all natural ingredients and there are no chemical preservatives added in it.

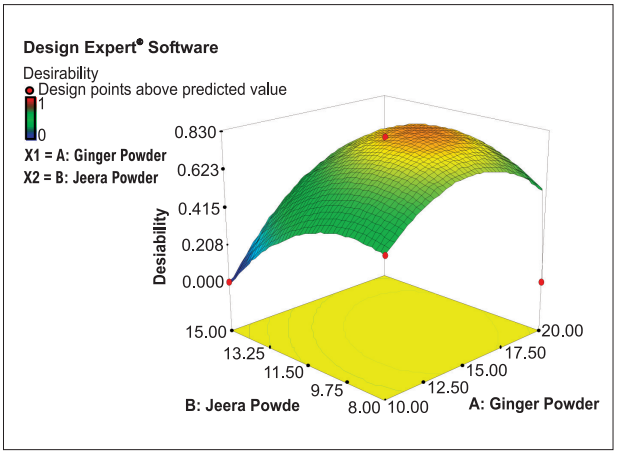

Fig. 3—Optimized levels of independent variables of *Jeera* Munch

The proximate composition reveals that the *jeera* munch is a carbohydrate (70.7% by difference) rich product with the calorific value of 77.7 Kcal per serving of 20 g. The protein, fat, ash and crude fibre contents of the optimized munch were 8.82, 7.83, 3.01 and 7.2 percent, respectively. As it contains lemon juice, ginger and raisins as ingredients, the vitamin C content of the appetizer was estimated and was found to be 5.5±0.4 mg%. The level of the appetite influencing spices in *jeera* munch was 25.3%. The storage stability studies of the munch at different temperatures indicates that the acceptability of the product was very good initially with a score of 3.4 to 3.7 on 5 point hedonic scale (Table 4). After 9 months of storage, *jeera* munch was found to be acceptable and was rated above good as the sensory evaluation parameters were not much changed (P>0.05). TBA value which measures the oxidative change has increased (P<0.05) over the storage period; however, the extent of increase is not considerable for the product quality since it has no influence on the flavour or acceptance of the product. Pandey *et al*[10] also reported insignificant changes in sensory properties of a fat rich sweet product, *rabri* powder during storage. For an instant sweet mix preparation of soybean and semolina, a shelf-life of 6 months has been reported[15] when stored in PP pouches in ambient conditions, as a result of changes in sensory and TBA values. Similar munches based on pepper have been reported to have shelf-life of 9 months in metalized polyester pouches[16]. The *jeera* munch reported in the present study, when given to human volunteers resulted in 6.4% reduction in their plasma leptin level. This confirms the appetizing ability of the appetizer, as the level of leptins in blood plasma indicates the magnitude of appetite[17].

Table 4—Storage changes of *Jeera* munch

Period (months)	Storage Temp. (°C)	Colour	Aroma	Taste	Texture	OAA Score[a]	TBA value[b]
0	-	3.25±0.2	3.35±0.2	3.45±0.3	3.40±0.1	3.40±0.1	0.03
3	RT	3.15±0.1	3.31±0.2	3.3±0.4	3.3±0.1	3.30±0.2	0.10
	37	3.00±0.2	3.15±0.1	3.15±0.3	3.15±0.3	3.15±0.4	0.18
6	RT	3.05±0.3	3.25±0.5	3.25±0.5	3.25±0.2	3.25±0.3	0.16
	37	2.90±0.3	3.00±0.3	3.00±0.2	3.00±0.4	3.10±0.1	0.24
9	RT	2.85±0.2	3.05±0.4	2.95±0.2	2.95±0.3	3.20±0.4	0.20
	37	2.70±0.3	2.80±0.3	2.80±0.1	2.80±0.2	3.08±0.2	0.27

[a]Overall acceptability on 5 - point Hedonic Scale (n=15 panelists)
[b]Thiobarbituric acid value (mg malonaldehyde/kg sample) (n=3)

Conclusion

An ready-to-eat appetizer, *jeera* munch based on natural ingredients was developed using Response Surface Methodology. The product has excellent sensory acceptance and a shelf-life of 9 months in ambient conditions as well as 37°C and is well suited for high altitude areas due to its functionality.

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