

To study sensory quality and production cost of Khoa Modak blended with Jaggery and Pumpkin seeds

Abstract

The present investigation entitles “Evaluation of Khoa Modak blended with Jaggery and Pumpkin (*Cucurbita Pepo* L.) seeds” was conducted at Dairy Science Laboratory of Department of Animal Husbandry and Dairy Science, College of Agriculture, Dr. BSKKV., Dapoli (M.S.) to incorporate Jaggery and Pumpkin seeds successfully in preparation of Khoa Modak.

This study aimed to evaluate processed for manufacturing of Khoa Modak blended with Jaggery and Pumpkin (*Cucurbita pepo* L.) seeds and to study effect of different levels of Jaggery and Pumpkin seeds on sensory quality and production cost of Khoa Modak.

In present study, blend of Jaggery and Pumpkin seeds was successfully used in preparation of Khoa Modak at four levels of Jaggery i.e., 12, 15, 18 and 21 per cent and Pumpkin seeds were added at two levels 5 and 7.5 per cent, respectively. It was found that 18 per cent Jaggery and 7.5 per cent Pumpkin seeds was best treatment (J_3P_2) in present study.

Khoa Modak with 18 per cent Jaggery and 7.5 per cent Pumpkin seeds had the highest overall acceptability score. The rigorous evaluation of the data indicates that of all the levels of Jaggery and Pumpkin seeds were significant ($p < 0.01$) and had highest scored, the best product was obtained with 18 per cent Jaggery and 7.5 per cent Pumpkin seeds content. Hence, 18 per cent was chosen the most optimal level of Jaggery and 7.5 per cent of Pumpkin seeds for Khoa Modak preparation. At this quantity of Jaggery and Pumpkin seeds at 18 per cent and 7.5 per cent generated the highest quality product, with a score of treatment J_3P_2 (8.64). As a result, a reasonable level of Jaggery at 18 per cent and Pumpkin seeds at 7.5 per cent for producing the best quality Khoa Modak.

The addition of Jaggery and Pumpkin seeds reduced the cost of producing Khoa Modak proportionally. The cost of Khoa Modak under treatments J_1P_1 , J_1P_2 , J_2P_1 , J_2P_2 , J_3P_1 , J_3P_2 , J_4P_1 and J_4P_2 was Rs. 331.62, Rs.337.23, Rs.327.08, Rs.332.65, Rs.322.76, Rs.328.28, Rs.318.65, Rs.324.12 per kg., respectively.

Key words:- Khoa Modak, Jaggery, pumpkin seeds.

Introduction:-

Milk is a highly nutritious liquid produced by the mammary glands of mammals. It is a primary source of nutrition for young mammals before they can digest solid food. The constituents of milk are water, fat, proteins, lactose and salts which are its main constituents and determine its nutritional and commercial value. Cow milk is a complete food, which covers almost all the needs of the human body. Precisely, it consists of proteins, lactose, triglycerides, phosphorus, calcium and vitamins (B₂, A and mainly D). It is rich in calcium and lysine, an amino acid that is often missing from plant proteins (Lambrini et al., 2020).

Khoa is a heat-desiccated Indian traditional dairy product made by continuously boiling milk until the necessary milk solids concentration (60-70 %) is achieved (Kumar et al. 2016). FSSAI (2011) requires a minimum of 30 per cent fat on dry matter, no added starch, sugar, or colouring and 0.1 per cent citric acid by weight.

India is the country with the highest production and consumption of Jaggery. More than 70 per cent of global manufacturing occurs in India. The major sugarcane producing states of India are Karnataka, Maharashtra, Tamil Nadu, Uttar Pradesh and Andhra Pradesh contributing to around 80-90 per cent of Jaggery production. Out of the 300 MT of sugarcane produced in India, 53 per cent is converted into white sugar, 3 per cent is used for cane juice, 36 per cent is processed into Jaggery and khandsari and 8 per cent is used as cane seed. India would need at least 54 MT of sweeteners, out of this about 40 per cent has to be met by Jaggery (Pravallika et al., 2018). Jaggery is high in minerals (calcium, magnesium, potassium, phosphorus, sodium, iron, manganese, zinc, copper and chloride) and vitamins (A, B₁, B₂, B₅, B₆, C and D₂). Jaggery contains micronutrients with antitoxic and anticarcinogenic effects. It contains moderate amounts of calcium, phosphorus and zinc (Shrivastav et al., 2016).

Pumpkin seeds are a locally available, underutilized and viable food source. These contain nutrients and therapeutic characteristics. Pumpkin seeds contain oil, protein, fibre and essential minerals. These seeds are a rich source of nutrients, including zinc, phosphorus, magnesium, potassium and selenium, which can help combat disorders like arthritis, inflammation, prostate cancer, etc. (Maheshwari et al., 2015).

Khoa Modak, a classic Indian sweet, is a popular confection composed mostly of khoa, a dairy product created by slowly boiling whole milk. Khoa Modak, known for its rich, creamy texture and pleasantly sweet flavor, is frequently formed into small, intricate molds that resemble traditional Modak, which is used as a symbolic offering during Hindu festivals such as Ganesh Chaturthi. Khoa Modak is made by meticulously reducing milk to remove the majority of its water content, resulting in a solid, nutrient-rich base that serves as the foundation for many Indian

desserts. This ancient approach ensures that Khoa Modak is both delicious and high in critical elements including protein, calcium and vitamins.

Material and method: -

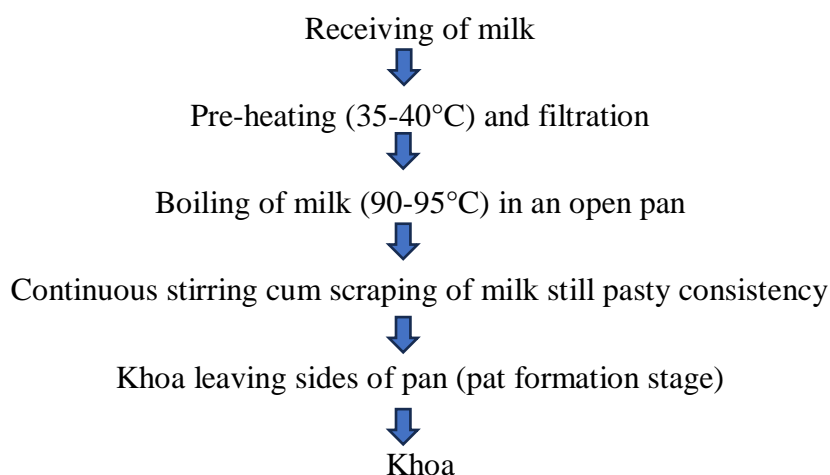
All the material required was procured from local market and also facilities provided by Department of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli, Ratnagiri,(M.S) India.

Method Adopted

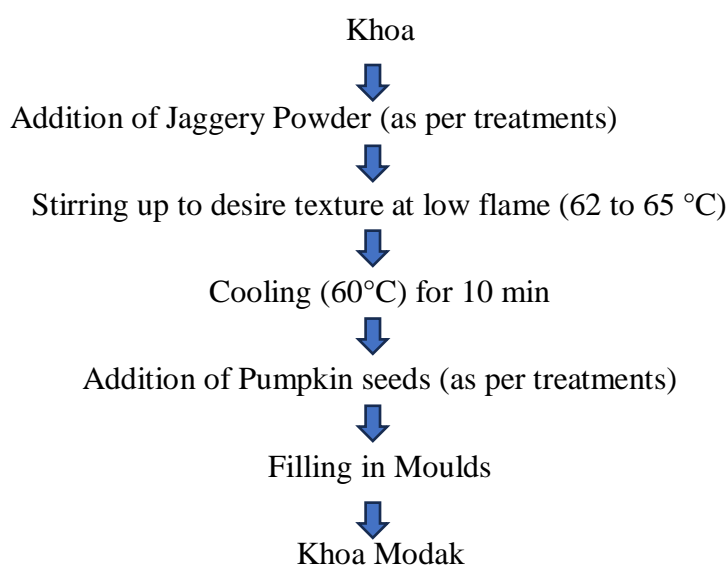
Preparation of Jaggery Modak:-Jaggery Modak was prepared in two steps

Flow chart for preparation of Khoa Modak blended with Jaggery and Pumpkin (*Cucurbita pepo* L.) seeds. Jaggery Modak was prepared as per procedure given by Gavhane et al. (2012) with slight modification.

STEP 1:- Preparation of Khoa



STEP 2 :-Preparation of Khoa Modak



3.2.1 Experimental Details

The experiment was conducted with Khoa blended with Jaggery and Pumpkin (*Cucurbita pepo* L.) seeds. There were four different levels of Jaggery and two levels of Pumpkin seeds were used on the basis of final weight of khoa obtain from milk.

3.2.2 Treatment Details

Treatments	Treatment Details
J ₁ P ₁	100 per cent Khoa + 12 per cent Jaggery + 5 per cent Pumpkin seeds
J ₁ P ₂	100 per cent Khoa + 12 per cent Jaggery + 7.5 per cent Pumpkin seeds
J ₂ P ₁	100 per cent Khoa + 15 per cent Jaggery + 5 per cent Pumpkin seeds
J ₂ P ₂	100 per cent Khoa + 15 per cent Jaggery + 7.5 per cent Pumpkin seeds
J ₃ P ₁	100 per cent Khoa + 18 per cent Jaggery + 5 per cent Pumpkin seeds
J ₃ P ₂	100 per cent Khoa + 18 per cent Jaggery + 7.5 per cent Pumpkin seeds
J ₄ P ₁	100 per cent Khoa + 21 per cent Jaggery + 5 per cent Pumpkin seeds
J ₄ P ₂	100 per cent Khoa + 21 per cent Jaggery + 7.5 per cent Pumpkin seeds

Sensory Evaluation

The product was been served to a panel of 8-10 semi trained judges for organoleptic evaluation. Sensory evaluation shall be carried out by adopting 9 points Hedonic scale method as per IS: 6273, Part-I (1971). The Khoa Modak was evaluated by the judges for sensory attributes like colour and appearance, body and texture, flavour and overall acceptability.

Cost of Production

The material/ingredients needed for the preparation of Khoa Modak blended with Jaggery and Pumpkin seeds were rated as per the current market rates (2023-24) and cost of production of Khoa Modak blended with Jaggery and Pumpkin seeds was worked out.

Statistical analysis: -

The experimental design was used for statistical analysis are Factorial Completely Randomized Design (FCRD) using eight treatments and five replications.

Results and Discussion

1 Sensory evaluation of Khoa Modak

1.1 Colour and appearance

The data pertaining to sensory score for colour and appearance at different treatments are given in Table 1

Table 1.0 Effect of different levels of Jaggery and Pumpkin seeds on Colour and appearance of Khoa Modak (out of nine)

Levels of Pumpkin Seeds (%)	Levels of Jaggery (%)				Mean
	J ₁ (12)	J ₂ (15)	J ₃ (18)	J ₄ (21)	
P ₁ (5)	7.42	7.75	8.22	7.98	7.84
P ₂ (7.5)	7.59	7.92	8.27	8.11	7.97
Mean	7.51	7.84	8.25	8.04	7.91

ANOVA Table

SV	DF	SS	MSS	Cal F	Tab F (5%)	Tab F (1%)	Sig
Treatment	8	3.20	0.40	6.31	2.24	3.13	S
Jaggery	3	3.01	1.00	15.81	2.90	4.46	S
Pumpkin seeds	1	0.17	0.17	2.65	4.15	7.50	NS
Interaction	3	0.02	0.01	0.13	2.90	4.46	NS
Error	32	2.03	0.06	--	--	--	--
Total	39	--	--	--	--	--	--

Particulars	S.E.(M)	C.D. 1%	C.D. 5%	5%	1%
Jaggery	0.08	0.11	0.23	S	S
Pumpkin seeds	0.06	0.08	0.16	NS	NS
Interaction	0.11	0.16	0.32	NS	NS

The table for point 1.0 indicator that as the level of Jaggery goes on increasing there was increase in the score for colour up to 18 per cent inclusion. However, at 21 per cent level there was reduction in score. The colour of Jaggery is reddish so it has been observed that with the increasing level of Jaggery the product obtains faint reddish brown to deep reddish in colour which was accepted by judges. However, at 21 per cent inclusion the colour became dense reddish brown which was not accept much by judges and so there was reduction in score.

As regards to Pumpkin seed it does not have any specific colour. However, they are slightly off white in colour.

Results indicated that addition of 7.5 per cent Pumpkin seeds provided better results than addition of 5 per cent Pumpkin seeds addition it might be due to fact that off white colour of Pumpkin seed provided typical brightness to the product resulting in higher score.

The statistical examination of the data revealed no significant differences related to interaction of Jaggery and Pumpkin seeds. The inclusion of Jaggery significantly affect the difference in colour and appearance scores of Khoa Modak due to varied quantities of Jaggery. However, inclusion of Pumpkin seeds did non-significantly affect colour and appearance of Khoa Modak.

The present investigation is similar to findings of Chaudhari (2015) observed that, as the

level of carrot pulp increased, the colour and appearance of burfi increases up to certain limit and thereafter it decreased score (18.55 to 15.18).

Hoshing et al. (2023) studies on sensory qualities of burfi prepared from cow milk Khoa and beetroot (*Beta vulgaris*) pulp. They observed as the level of beetroot pulp increases, the colour and appearance of burfi increases up to certain limit and thereafter it decreased score (8.70 to 6.90).

Body and texture

The data pertaining to sensory score for body and texture in respect of Khoa Modak are given in Table 2.0

Table 2.0 Effect of different levels of Jaggery and Pumpkin seeds on Body and Texture of Khoa Modak (out of nine)

Levels of Pumpkin seeds (%)	Levels of Jaggery (%)				Mean
	J ₁ (12)	J ₂ (15)	J ₃ (18)	J ₄ (21)	
P ₁ (5)	7.03	7.16	7.71	8.00	7.48
P ₂ (7.5)	7.10	7.37	7.80	8.09	7.59
Mean	7.06	7.27	7.75	8.05	7.53

ANOVA Table

SV	DF	SS	MSS	Cal F	Tab F (5%)	Tab F (1%)	Sig
Treatment	8	6.22	0.78	1.76	2.24	3.13	NS
Jaggery	3	6.06	2.02	4.58	2.90	4.46	S
Pumpkin seeds	1	0.13	0.13	0.30	4.15	7.50	NS
Interaction	3	0.03	0.01	0.03	2.90	4.46	NS
Error	32	14.11	0.44	--	--	--	--
Total	39	--	--	--	--	--	--

Particulars	S.E.(M)	C.D. 1%	C.D. 5%	5%	1%
Jaggery	0.21	0.30	0.60	S	S
Pumpkin seeds	0.15	0.21	0.43	NS	NS
Interaction	0.30	0.42	0.85	NS	NS

Table 2.0 shows effect of different level of Jaggery and Pumpkin seeds on body and texture of Khoa Modak. Normal texture of Jaggery is granular which provided ideal texture expected from Khoa Modak so it has been observed that as the levels of Jaggery increased this was increased in the score for body and texture parameter. However, it has been found at 21 per cent was very marginal e.g. there was about 7-8 per cent increase in score when level of Jaggery increase from 15-18 per cent. However, when level was 21 per cent the increase in score was merely 3-4 per cent

As regards to Pumpkin seeds it showed slight impact on body and texture of final product. However, there was slight increase in score for body and texture of Khoa Modak at higher level of addition of Pumpkin seeds i.e. 7.5 per cent.

Statistically interaction effect of both the factor i.e. Jaggery and Pumpkin seeds are found non-significant at ($p < 0.01$) level of significance.

It was concluded that both Jaggery has significant effect on body and texture of Khoa modak while Pumpkin seeds have non-significantly effect on final product Khoa Modak.

These finding are closely similar to Bhutkar et al. (2015) They studied the preparation of Peda blended with red pumpkin. They observed that increasing proportion of red pumpkin pulp in the blended in the khoa increased the score in respect of body and texture ranged between 8.0 to 9.0 for T_1 and T_3 treatment combinations.

Flavour

The score obtained for flavour at different treatments are determine in Table 3.0

Table 3.0 Effect of different levels of Jaggery and Pumpkin seeds on Flavour of Khoa Modak (out of nine)

Levels of Pumpkin seeds (%)	Levels of Jaggery (%)				Mean
	J ₁ (12)	J ₂ (15)	J ₃ (18)	J ₄ (21)	
P ₁ (5)	5.67	6.57	7.16	7.61	6.75
P ₂ (7.5)	5.97	6.80	7.28	7.86	6.98
Mean	5.82	6.68	7.22	7.73	6.87

ANOVA Table

SV	DF	SS	MSS	Cal F	Tab F (5%)	Tab F (1%)	Sig
Treatment	8	20.52	2.56	9.88	2.24	3.13	S
Jaggery	3	19.96	6.65	25.64	2.90	4.46	S
Pumpkin seeds	1	0.51	0.51	1.98	4.15	7.50	NS
Interaction	3	0.04	0.01	0.06	2.90	4.46	NS
Error	32	8.30	0.26	--	--	--	--
Total	39	--	--	--	--	--	--

Particulars	S.E.(M)	C.D. 1%	C.D. 5%	5%	1%
Jaggery	0.16	0.23	0.46	S	S
Pumpkin seeds	0.11	0.16	0.33	NS	NS
Interaction	0.2278	0.3221	0.66	NS	NS

Table 3.0 shows effect of different level of Jaggery and Pumpkin seeds on Flavour of Khoa Modak (out of nine). The variation in the taste score caused by different treatments was found to be considerable.

Jaggery is known for its typical burnt sweet, flavour so addition of Jaggery resulted in providing these typical taste and aroma to the product resulting in higher score for flavour parameter as level of Jaggery increases

The pumpkin seeds did not provide any pronounce effect on flavour attribute of the product because Pumpkin seed as such are flavour less.

Statistical data revealed that interaction effect of Jaggery and Pumpkin seeds was found non-significant at ($p < 0.01$) levels of significance. Jaggery was found significant effect on final product while Pumpkin seeds was found non-significant effect on Khoa modak.

The present study was quite similar to findings of Bhutkar et al. (2015) They studied the preparation of Peda blended with red pumpkin. They observed that increasing proportion of red pumpkin pulp in the blended in the khoa increased the score in respect of flavour ranged between 8.0 to 9.0 for T_1 and T_3 treatment combinations.

Overall acceptability

The effect of Jaggery and Pumpkin seeds on overall acceptability of Khoa Modak is tabulated in Table 4.0

Table 4.0 Effect of different levels of Jaggery and Pumpkin seeds on Overall acceptability of Khoa Modak (out of nine)

Levels of Pumpkin seeds (%)	Levels of Jaggery (%)				Mean
	J ₁ (12)	J ₂ (15)	J ₃ (18)	J ₄ (21)	
P ₁ (5)	7.40	7.64	7.76	8.62	7.85
P ₂ (7.5)	7.51	7.67	8.64	8.25	8.02
Mean	7.46	7.65	8.20	8.44	7.94

ANOVA Table

SV	DF	SS	MSS	Cal F	Tab F (5%)	Tab F (1%)	Sig
Treatment	8	8.62	1.08	37.45	2.24	3.13	S
Jaggery	3	6.31	2.10	73.05	2.90	4.46	S
Pumpkin seeds	1	0.27	0.27	9.29	4.15	7.50	S
Interaction	3	2.05	0.68	23.71	2.90	4.46	S
Error	32	0.92	0.03	--	--	--	--
Total	39	--	--	--	--	--	--

Particulars	S.E.(M)	C.D. 1%	C.D. 5%	5%	1%
Jaggery	0.05	0.08	0.15	S	S
Pumpkin seeds	0.04	0.05	0.11	S	S
Interaction	0.075	0.11	0.22	S	S

According to the overall acceptance scores shows in Table 4.0. It has been observed that treatment J₃P₂ (8.64) contain 18 per cent Jaggery and 7.5 per cent Pumpkin seeds provided most

acceptable product it might be because of combine effect of typical aroma and flavour of Jaggery coupled with brightness of Pumpkin seeds.

The results indicated that both Jaggery and Pumpkin seeds are having significant impact on overall acceptability of product.

Statistical analysis of data indicated that there is significant effect of Jaggery and Pumpkin seeds on overall acceptability of Khoa Modak at ($p < 0.01$) level of significance. Interaction effect of both the factors found significant.

The present experimental study was similar to findings of Bhutkar et al. (2015) They studied the preparation of Peda blended with red pumpkin. They observed Peda samples in which 10 per cent red pumpkin pulp was blended with khoa scored the highest score (8.87) as compare to other treatments.

Cost of Production of Khoa Modak

The effect of different levels of Jaggery and Pumpkin seeds on cost of production of Khoa Modak is presented in Table 5.0. The cost of producing 1 kg of Khoa Modak was found to be Rs. 328.28 in case of Khoa Modak prepared from 18 per cent Jaggery and 7.5 per cent Pumpkin seeds. The addition of Jaggery and Pumpkin seeds reduced the cost of producing Khoa Modak proportionally. The cost of Khoa Modak under treatments J_1P_1 , J_1P_2 , J_2P_1 , J_2P_2 , J_3P_1 , J_3P_2 , J_4P_1 and J_4P_2 was Rs. 331.62, Rs.337.23, Rs.327.08, Rs.332.65, Rs.322.76, Rs.328.28, Rs.318.65, Rs.324.12 per kg., respectively.

Cost of production of Khoa Modak was more comparable with Bhutkar et al. (2015) demonstrated the cost of final product was decreased from (T_1) Rs.260, (T_2) Rs.251, (T_3) Rs. 242 to (T_4) Rs. 234 per kg, respectively.

Table 5 Cost of Production of Khoa Modak per kg in (Rs.) based on cost of Ingredients only

Ingredients	Price (Rs.)	Treatments															
		J ₁ P ₁		J ₁ P ₂		J ₂ P ₁		J ₂ P ₂		J ₃ P ₁		J ₃ P ₂		J ₄ P ₁		J ₄ P ₂	
		Qty (g)	Cost (Rs.)	Qty (g)	Cost (Rs.)	Qty (g)	Cost (Rs.)	Qty (g)	Cost (Rs.)	Qty (g)	Cost (Rs.)	Qty (g)	Cost (Rs.)	Qty (g)	Cost (Rs.)	Qty (g)	Cost (Rs.)
Milk/ (lit)	56/-	600 (ml)	34	600 (ml)	34	600 (ml)	34	600 (ml)	34	600 (ml)	34	600 (ml)	34	600 (ml)	34	600 (ml)	34
Khoa/kg		100	34	100	34	100	34	100	34	100	34	100	34	100	34	100	34
Jaggery/ (kg)	150/-	12	1.8	12	1.8	15	2.25	15	2.25	18	2.70	18	2.70	21	3.15	21	3.15
Pumpkin seeds/(kg)	600/-	5	3.0	7.5	4.5	5	3.0	7.5	4.5	5	3.0	7.5	4.5	5	3.0	7.5	4.5
Total quantity of Khoa Modak Prepared (g)		117	38.80	119.5	40.30	120	39.25	122.5	40.75	123	39.70	125.50	41.20	126	40.15	128.50	41.65
Total cost (Rs.) of Khoa Modak/kg		331.62		337.23		327.08		332.65		322.76		328.28		318.65		324.12	

Cost of Ingredients: - Cow milk Rs.56/lit,

Khoa Rs.340/kg

Jaggery Rs.150/kg,

Pumpkin seeds Rs.600/kg

Summary

Sensory evaluation of Khoa Modak

Colour and appearance

From the above Table 1.0 it was observed that the highest score was attained with 18 per cent Jaggery and 7.5 per cent of Pumpkin seeds in treatment J₃P₂ (8.27) and the lowest score of treatment J₁P₁ (7.42) was obtained when 12 per cent Jaggery and 5 per cent of Pumpkin seeds was added, it could be attributed to the judges' dislike of Jaggery's light colour.

Body and texture

Table 2.0 showed Effect of different level of Jaggery and Pumpkin seeds on Body and Texture of Khoa Modak. Score of body and texture at 21 per cent of Khoa Modak has highest sensory score of treatment J₄P₂ is 8.09 and lowest in treatment J₁P₁ score 7.03. It had proper body texture and smoothness due to moisture of Jaggery.

Flavour

The flavour recorded at 21 per cent Jaggery which was greater than that at 12 per cent and 15 per cent and 18 per cent Jaggery, which was scaled up with scores of 5.67, 6.57 and 7.16 possibly due to the product's deep sweetness, which was liked by the judges. The judges preferred the product with the highest grade of treatment J₄P₂ (7.86) at 21 per cent Jaggery level for its mild sweetness and 7.5 per cent Pumpkin seeds level for its crispiness.

Overall acceptability

Khoa Modak with 18 per cent Jaggery and 7.5 per cent Pumpkin seeds had the highest overall acceptability score. The rigorous evaluation of the data indicates that of all the levels of Jaggery and Pumpkin seeds were significant ($p < 0.01$) and had highest scored, the best product was obtained with 18 per cent Jaggery and 7.5 per cent Pumpkin seeds content. Hence, 18 per cent was chosen the most optimal level of Jaggery and 7.5 per cent of Pumpkin seeds for Khoa Modak preparation. At this quantity of Jaggery and Pumpkin seeds at 18 per cent and 7.5 per cent generated the highest quality product, with a score of treatment J₃P₂ (8.64). As a result, a reasonable level of Jaggery at 18 per cent and Pumpkin seeds at 7.5 per cent for producing the best quality Khoa Modak.

Cost of Production of Khoa Modak

The cost of producing one kg of Khoa Modak was found to be Rs. 328.28 in case of Khoa Modak prepared from 18 per cent Jaggery and 7.5 per cent Pumpkin seeds. The addition of Jaggery and Pumpkin seeds reduced the cost of producing Khoa Modak proportionally. The cost of Khoa Modak under treatments J₁P₁, J₁P₂, J₂P₁, J₂P₂, J₃P₁, J₃P₂, J₄P₁ and J₄P₂ was Rs. 331.62, Rs.337.23, Rs.327.08, Rs.332.65, Rs.322.76, Rs.328.28, Rs.318.65, Rs.324.12 per kg., respectively.

Conclusion

- a) Jaggery and Pumpkin seeds could be successfully used for the preparation of Khoa Modak.
- b) Used 18 per cent Jaggery and 7.5 per cent Pumpkin seeds to prepare most desirable and acceptable Khoa Modak.
- c) Incorporation of Jaggery and Pumpkin seeds was suggested at pat formation stage.
- d) Sensory score for all parameters of khoa modak increases as addition of Jaggery and Pumpkin seeds
- e) Production cost of Khoa Modak decreases when addition of different levels of Jaggery and Pumpkin seeds
- f) Significant difference was observed in organoleptic quality due to different levels of Jaggery and Pumpkin seeds in Khoa Modak.

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