Plant Archives Vol. 20, Supplement 1, 2020 pp. 3335-3342 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

PROCESS OPTIMIZATION THROUGH VALUE ADDITION FOR THE MANUFACTURE OF ALMOND SUPPLEMENTED *PANEER KHEER*

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Abstract

Research was conducted to optimize the process of manufacturing almond supplemented *Paneer kheer* by evaluating it's Textural (Chewiness, Gumminess and Springiness), Physico-Chemical (Titratable Acidity and pH) and Sensory attributes (Colour and Appearance, Sweetness, Flavor, Consistency and Overall Acceptability). The research was performed in the laboratory of Dairy Science and Food Technology Department in Banaras Hindu University under CRD. The result revealed that maximum mean score of flavour (8.80), sweetness (8.75), colour and appearance (8.55), chewiness (326.158), gumminess (332.566), springiness (0.978), pH (6.31) was obtained when almond supplemented *Paneer kheer* was prepared with 6% almond while with same percent of almond the minimum mean score of TA was obtained. Mean score of overall acceptability at control condition was found to be lower (8.22) as compared to 8.63 under optimized condition.

Key words : Acceptability, Color and Appearance, Textural, Optimization, & *Paneer kheer*.

Introduction

India is considered as an agrarian country in which major proportion of population is vegetarian. Milk plays an important role in the diet of such persons as a source Proteins. India is the largest milk producer in the world with a production of 176.3 million tonnes of milk per annum and per capita availability of milk in India was 375g/day in 2017-18 (NDDB 2017-18) as against the recommended level of 280 g/per capita per day by (ICMR). The dairy sector in India grew at a rate of 6.4 % annually in the last four years against the global growth rate 1.7 percent. A significant portion of milk production in India is converted into a variety of indigenous milk products. The indigenous milk products prepared are given in following table:-

1. Concentrated whole milk products Khoa, Rabri, Kheer/ Basundi etc.
2. Coagulated milk products Paneer, Chhana, etc.
3. Fat rich products Ghee, Makkhan, Gheeresidue etc.
4. Frozen milk products Kulfi, malaikaBaraf etc.
5 Fermented milk products Dahi, Lassi etc.

Paneer is the product obtained from cow or buffalo or a combination thereof by precipitation with sour milk, lactic acid or citric acid. It should not contain more than 70% moisture and the milk fat content should not be less than 50% of the dry matter basis. (PFA, 1976). Bureau of Indian Standards also specifies a minimum of 50% fat on dry matter basis but a maximum of 60% moisture in *paneer* (BIS, 1986). *Paneer* is used in preparation of vegetables, pakoras, snacks, mishti etc. The major factor which has sustained its significance in the Indian culinary tradition is the presence of essential nutrition elements, such as dietary fibre, calcium, phosphorus, vitamin D, vitamin B, and omega-3 & omega-6 fatty acids.

Paneer should have a characteristic blend of flavor of heated milk and acid. It's body and texture must be sufficiently firm to hold its shape during cutting /slicing, yet it must be tender enough not to resist crushing during mastication, i.e. the texture must be compact and smooth; its colour ad appearance must be uniform, pleasing white, with a greenish tinge in the case of buffalo milk *paneer* and light yellow in the case of cow milk paneer (Desai 2007). Paneer contain all the milk constituents except for the loss of soluble whey protein, lactose and minerals (Singh & Kanawajia 1988).Paneer has a fairly high level of fat (22-25 %) and protein (16-18%) and low level of

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lactose (2-2.7%) (Kanawajia & Singh, 1996).Cow milk *paneer* has a soft and spongy body and relatively open texture whereas, buffalo milk *paneer* has firm and spongy body and a close texture (Sindhu 1996).Homogenization of cow milk improved the yield and organoleptic score of paneer (Vishweshwaraiah and Anantakrishnan, 1985).

Paneer keeps well for about a day at ambient temperature and for about a week under refrigeration (7°C). The spoilage of *paneer* is mainly due to bacterial action. Successful attempts have been made to enhance the shelf life of *paneer* (Kumbhar *et al.*, 2011). According, to the report, the global *paneer* market grew at a CAGR of around 6.7% during 2010-2017 reaching a volume of 1.7 Million Metric Tons in 2017 (Research and Markets.com's).

Traditional Indian products include several innovative blends used in the preparation of different variety of milk based delicacies. Among them Kheer is one which is popular in the northwest, central and eastern part of India, and is popular as *Payasam* in the southern part.

Kheer, a cereal based particulate dairy dessert is a unique product representing dairy and food processing going hand in hand. It has been the premier milk delicacy associated with festivities and celebration from the time immemorial and it has the status of a royal treat. No feast is considered complete without kheer. *Paneer kheer* is the base material for incorporating many types of dry fruits and different medicinal materials.

Almond based *Paneer kheer* is qualitatively highly nutritious and more favorable for body health because almond's have high fat, protein, and many types of essential minerals which are play a pivotal role in the body growth and development, most importantly almond have an antioxidant quality. Almonds are a source of vitamin E, copper, magnesium, and high-quality protein; they also contain high levels of healthy unsaturated fatty acids along with high levels of bioactive molecules (such as fiber, phytosterols, vitamins, other minerals, and antioxidants), which may help prevent cardiovascular disease (Karan Gill, 2017).

Objectives

- To optimize the process of manufacturing of almond supplemented *Paneer kheer*.
- To evaluate the Textural, Chemical and Microbial quality of almond supplemented *Paneer kheer.*

Materials and Methods

The experiment was conducted in the Laboratory of Dairy Science and Food Technology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. All together there were 45 treatments each of which were replicated 3 times. The experimental techniques were employed as under:

Texture profike analysis (TPA)

Almond supplemented *Paneer kheer* was analyzed for different textural characteristics like Gumminess, Chewiness and Springiness using a texture analyzer (Stable Micro System, Model TA-XT Plus, UK). In this experiment, a backward extrusion rig (A/BE 35 mm disc) was used as a probe. The product was subjected to compressive force by probe up to the distance of 35 mm two times. The conditions set in the texture analyzer for measuring textural properties of Almond supplemented *Paneer kheer* were as follows: Pre-Test Speed (1 mm/s), Post-Test Speed (5mm/s), Test speed (5mm/s), Trigger force (5.0 g), Time (5.0 s). For each evaluation, 80 g sample was used during texture analysis. Temperature of samples during textural analysis was maintained at 25°C.

Physico-chemical parameter

pH

The pH of almond supplemented *Paneer kheer* was determined as per procedure given in Manual in Dairy Chemistry, ICAR (1972) by using SYSTRONICS µ pH system 361.

Titratable acidity

Acidity was measured by titrating 10 g of sample against 0.1N NaOH using phenolphthalein indicator and expressed in terms of percent lactic acid as per the method described in IS:1479 (Part I) 1981.

Sensory evaluation

Sensory evaluation of Almond supplemented *Paneer kheer* was done on the basis of organoleptic tests by a meritorious panel of five judges of Department of Dairy Science and Food Technology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Samples were given code nos. to avoid bias opinion and individuality. The judges evaluated the samples taking in the consideration of Sweetness, Flavour, Colour and Appearance, Sweetness and overall acceptability of almond supplemented *Paneer kheer*. (IS 8140 – 1976)

Results and Discussion

Physico-chemical (Titratable Acidity and pH), textural profile analysis or texture analysis (Chewiness, Gumminess and Springiness) and Sensory attributes (Colour and Appearance, Sweetness, Flavor, Consistency and Overall Acceptability) of *Paneer kheer* were studied and the results pertaining to all the above characteristics

have been presented in this chapter with suitable table and statistical analysis under following major sub heading.

Treatment details

Forty-five different combinations of almond supplemented *Paneer kheer* have been manufactured by different ratio of almond, milk *paneer* and sugar.

(Note: A×B×C = A×M×S = Almond × Milk *Paneer* ratio × Sugar)

The detailed of the prepared combinations were as follows:

Flavour

Interactional effect of almond, milk *paneer* and sugar on flavour of the almond supplemented *Paneer kheer*

Treatment combinations of Almond, Milk *Panee r*and Sugar significantly influenced the flavour of almond supplemented *Paneer kheer*. The flavour score (8.80) has been obtained with $A_3B_2C_2$ combination which was statistically highly significance ($P<0.01$). The minimum mean score of flavour (7.50) was obtained with different combinations of Almond, milk *paneer* and sugars were also found significant. The maximum mean score (8.75) was found in different combinations of control *Paneer kheer* sample. The standard error means SE (m) of Almond, Milk *Paneer ratio* and Sugar combinations were 0.050. The critical difference of the combinations obtained was 0.142. This value proves the significance of the ($A_3B_2C_2$) combinations.

Sweetness

Interactional effect of almond, milk *paneer ratio* and sugar on sweetness of almond supplemented *Paneer kheer*

The treatment combinations of almond, milk *paneer ratio* and sugar levels significantly influenced the sweetness of almond supplemented *Paneer kheer*. The maximum sweetness score (8.75) has been obtained with ($A_3B_2C_2$) which was statistically significance level of ($p<0.05$). The minimum mean score of sweetness (7.50) was obtained with different treatment combinations of almond, milk *paneer ratio* and sugar levels. The maximum mean score (8.65) was found in different combinations of control *Paneer kheer* sample. The standard error (m) of almond, milk *paneer ratio* and sugar levels combinations were 0.090. The critical difference of these three different combinations was not obtained.

Colour & Appearance

Interactional effect of almond, milk *paneer ratio* and sugar levels on colour & appearance of almond supplemented *Paneer kheer*

The treatment combinations of almond, milk *paneer ratio* and sugar levels significantly impact on the colour and appearance of almond supplemented *Paneer kheer*. The best score of colour and appearance (8.55) have been obtained with $A_3M_2S_2$ which statistically significant and also A×B×C was found significant. The significance levels is ($p<0.05$). The minimum mean score (7.75) was obtained with different combinations of almond, milk *paneer ratio* and sugar levels. The maximum mean score (8.70) was found in different combinations of control *Paneer kheer* sample. This result concurs with the findings of Chetana *et al.*, 2004.

Consistency

Interactional effect of almond levels milk *paneer ratio* and sugar levels on consistency of almond supplemented *Paneer kheer*

The treatment combinations of almond, milk *paneer ratio* and sugar levels significantly influenced on the consistency of almond supplemented *Paneer kheer*. The maximum score of consistency (8.75) has been obtained with $A_3M_2S_2$ which was statistically significant with A×B×C. the significance level of the combinations less than 0.0001 which was found highly significant while, the minimum mean score (7.75) was found in among different treatment combinations. The maximum mean score (8.65) was found in different combinations of control *Paneer kheer* sample. The Standard Error SE (m) of almond, milk *paneer ratio and sugar* level combinations were found 0.041, the Critical Difference C. D. value of among significant treatment combinations obtained were 0.115.

Overall acceptability

Interactional effect of almond levels milk *paneer ratio and sugar* levels on overall acceptability of almond supplemented *Paneer kheer*

Treatment combinations of almond, milk *paneer ratio and* sugar levels significantly impact on the overall acceptability of almond supplemented *Paneer kheer*. The appropriate score was awarded on overall acceptability (8.73) has been obtained with $A_3M_2S_2$ which was statistically significant with AXBXC. The significance level is 0.0001, which is less than the ($p<0.05$) significance level. The minimum score (7.75) obtained with different combinations of almond, milk *paneer ratio and sugar* levels were also found significant. The maximum mean score (8.68) was found in different combinations of control *Paneer kheer* sample. The standard Error SE (m) of combinations was 0.040, whereas Critical Difference C.D. value of the combinations was found

Treatment	Descriptions
A0M1S1	*Represent* control *Paneer kheer* prepared from almond 0 % milk *paneer ratio* (850:150g) and sugar 2 %
A0M1S2	*Represent* control *Paneer kheer* prepared from almond 0% milk *paneer* ratio (850:150g) and sugar 2 %
A0M1S3	*Represent* control *Paneer kheer* prepared from almond 0% milk kheer ratio (850:150g) and sugar 2%
A0M2S1	*Represent* control *Paneer kheer* prepared from almond 0% milk kheer ratio (900:100g) and sugar 3 %
A0M2S2	*Represent* control *Paneer kheer* prepared from almond 0% milk *paneer ratio* (900:100g) and sugar 3%
A0M2S3	*Represent* control *Paneer kheer* prepared from almond o % milk *paneer ratio* (900:100g) and sugar 3 %
A0M3S1	*Represent* control *Paneer kheer* prepared from almond 0% milk *paneer ratio* (950:50g) and sugar 4 %
A0M3S2	*Represent* control *Paneer kheer* prepared from almond 0% milk *paneer ratio* (950:50) and sugar 4 %
AOM3S3	*Represent* control *Paneer kheer* prepared from almond 0% milk *paneer ratio* (950:50g) and sugar 4 %
A1M1S1	*Represent* almond supplemented *Paneer kheer* prepared from almond 2% milk *paneer ratio* (850:150g) and sugar 2%
A1M1S2	*Represent* almond supplemented *Paneer kheer* prepared from almond 2 % milk *paneer ratio* (850:150g) and sugar 2%
A1M1S3	*Represent* almond supplemented *Paneer kheer* prepare from almond 2 % milk *paneer ratio* (850:150g) and sugar 2%
A1M2S1	*Represent* almond supplemented *Paneer kheer* prepared from almond 2 % milk *paneer ratio* (900:100g) and sugar 3%
A1M2S2	*Represent* almond supplemented *Paneer kheer* prepared from almond 2 % milk *paneer ratio* (900:100g) and sugar 3%
A1M2S3	*Represent* almond supplemented *Paneer kheer* prepared from almond 2 % milk *paneer ratio* (900:100g) and sugar 3%
A1M3S1	*Represent* almond supplemented *Paneer kheer* prepared from almond 2 milk *paneer ratio* (950:50g) and sugar 4%
A1M3S2	*Represent* almond supplemented *Paneer kheer* prepared from almond 2 % milk *paneer ratio* n (950:50g) and sugar 4%
A1M3S3	*Represent* almond supplemented *Paneer kheer* prepared from almond 2 % milk *paneer ratio* (950:50g) and sugar 4%
A2M1S1	*Represent* almond supplemented *Paneer kheer* prepared from almond 4 % milk *paneer ratio* (850:150g) and sugar 2%
A2M1S2	*Represent* almond supplemented *Paneer kheer* prepared from almond 4 % milk *paneer ratio* (850:150g) and sugar 2%
A2M1S3	*Represent* almond supplemented *Paneer kheer* prepared from almond 4 % milk *paneer ratio* (850:150g) and sugar 2%
A2M2S1	*Represent* almond supplemented *Paneer kheer* prepared from almond 4 % milk *paneer ratio* (900:100g) and sugar 2%
A2M2S2	*Represent* almond supplemented *Paneer kheer* prepared from almond 4 % milk *paneer ratio* (900:100g) and sugar 3%
A2M2S3	*Represent* almond supplemented *Paneer kheer* prepared from almond 4 % milk *paneer ratio* (900:100g) and sugar 3%
A2M3S1	*Represent* almond supplemented *Paneer kheer* prepared from almond 4 % milk *paneer ratio* (950:0.50g) and sugar 4%
A2M3S2	*Represent* almond supplemented *Paneer kheer* prepared from almond 4 % milk *paneer ratio* (950:0.50g) and sugar 4%
A2M3S3	*Represent* almond supplemented *Paneer kheer* prepared from almond 4 % milk *paneer ratio* (950:0.50g) and sugar 4%
A3M1S1	*Represent* almond supplemented p[aneer kheer prepared from almond 6 % milk *paneer ratio* (850:150g) and sugar 2%
A3M1S2	*Represent* almond supplemented *Paneer kheer* prepared from almond 6 % milk *paneer ratio* (850:150g) and sugar 2%
A3M1S3	*Represent* almond supplemented *Paneer kheer* prepared from almond 6 % milk *paneer ratio* (850:150) and sugar 2%
A3M2S1	*Represent* almond supplemented *Paneer kheer* prepared from almond 6 % milk *paneer ratio* (900:100g) and sugar 3%
A3M2S2	*Represent*ed almond supplemented *paneer*prepared from almond 6 % milk *paneer ratio* (900:100g) and sugar 3 %
A3M2S3	*Represent* almond supplemented *Paneer kheer* prepared from almond 6% milk *paneer ratio* (900:100g)
A3M3S1	*Represent* almond supplemented *Paneer kheer* prepared from almond 6 % milk *paneer ratio* (950:0.50g) and sugar 4 %
A3M3S2	*Represent* almond supplemented *Paneer kheer* prepared from almond 6 % milk *paneer ratio* (950:0.50g) and sugar 4 %
A3M3S3	*Represent* almond supplemented *Paneer kheer* prepared from almond 6% milk *paneer ratio* (950:0.50g) and sugar 4%
A4M1S1	*Represent* almond supplemented *Paneer kheer* prepared from almond 8 % milk sugar ratio (850:150g) and sugar 2 %
A4M1S2	*Represent* almond supplemented *Paneer kheer* prepared from almond 8 % milk *paneer ratio* (850:150g) and sugar 2 %
A4M1S3	*Represent* almond supplemented *paneer*prepared from almond 8 % milk *paneer ratio* (850:150g) and sugar 2 %
A4M2S1	Repre3sent almond supplemented *Paneer kheer* prepared from almond 8 % milk *paneer ratio* (900:100g) and sugar 3%
A4M2S2	*Represent* almond supplemented *Paneer kheer* prepared from almond 8 % milk *paneer ratio* (900:100g) and sugar 3 %
A4M2S3	*Represent* almond supplemented *Paneer kheer* prepared from almond 8 % milk *paneer ratio* (900:100) and sugar 3 %
A4M3S1	*Represent* almond supplemented paneere kheer prepared from *Paneer kheer* ratio (950:0.50g) and sugar 4 %
A4M3S2	*Represent* almond supplemented Paneer kheer prepared from almond 8 % milk *paneer ratio* (950:0.50g) and sugar 4 %
A4M3S3	*Represent* almond supplemented *Paneer kheer* prepared from almond 8 % milk *paneer ratio* (950:0.50g) and sugar 4 %

Experimental runs and actual values for factors used for control and optimized almond supplemented *Paneer kheer*

Variables	Sensory Attributes on 9 point hedonic scale								Texture Profile Analysis (TPA)			Physico-Chem	
SN	Attribu.	Alm.(%)	M:P (g)	Sugar(%)	Flavor	Sweetness	Col.& App.	Consistency	OAA	Chewiness	Gumminess	Springiness	TA%	pH
+1	A0M1S1	0	850:150	2	8.25	8.35	8.5	8.1	8.26	71.964	71.318	0.904	0.44	5.93
2	A0M1S2	0	850:150	2	8	8.3	8.25	8.25	8.2	70.044	70.995	0.915	0.41	5.95
3	A0M1S3	0	850:150	2	8.35	8.32	8.2	8.3	8.30	65.888	71.307	0.895	0.36	5.91
4	A0M2S1	0	900:100	3	8.25	8.25	8.1	8.4	8.25	66.489	71.205	0.818	0.33	5.95
5	A0M2S2	0	900:100	3	8.75	8.65	8.7	8.65	8.68	70.508	71.671	0.985	0.28	6.3s0
6	A0M2S3	0	900:100	3	8.6	8.4	8.34	8.5	8.46	69.402	70.028	0.898	0.32	6.24
7	A0M3S1	0	950:050	4	8.5	8.5	8.4	8.5	8.48	67.701	71.410	0.901	0.36	6.16
8	A0M3S2	0	950:050	4	8	8.25	7.75	8	8.00	69.914	71.315	0.925	0.34	5.93
9	A0M3S3	0	950:050	4	7.5	8	7.5	7.8	7.69	69.511	71.015	0.932	0.32	5.95
10	A1M1S1	2	850:150	2	8.15	8.00	8.00	8.00	8.04	91.079	110.101	0.302	0.36	5.93
11	A1M1S2	2	850:150	2	8.30	8.10	8.25	8.20	8.21	93.255	110.008	0.314	0.39	5.92
12	A1M1S3	2	850:150	2	8.40	8.27	8.40	8.40	8.36	101.677	110.028	0.306	0.34	5.91
13	A1M2S1	2	900:100	3	8.50	8.40	8.50	8.50	8.44	106.177	109.225	0.315	0.38	5.95
14	A1M2S2	2	900:100	3	8.30	8.30	8.50	8.40	8.35	108.386	110.855	0.326	0.34	5.94
15	A1M2S3	2	900:100	3	8.20	8.15	8.43	8.25	8.24	106.525	110.104	0.312	0.32	5.97
16	A1M3S1	2	950:050	4	8.03	8.00	8.20	8.1	8.09	107.158	109.209	0.301	0.35	5.93
17	A1M3S2	2	950:050	4	7.90	7.85	8.00	8.00	8.00	108.118	109.858	0.315	0.33	5.94
18	A1M3S3	2	950:050	4	7.75	7.75	7.75	7.80	7.76	108.025	109.878	0.318	0.36	5.90
19	A2M1S1	4	850:150	2	7.90	8.00	8.00	7.90	7.95	105.525	214.159	0.621	0.35	5.93
20	A2M1S2	4	850:150	2	8.00	8.10	8.15	8.20	8.11	209.505	220.724	0.631	0.39	5.93
21	A2M1S3	4	850:150	2	8.30	8.25	8.25	8.35	8.29	213.605	219.569	0.632	0.37	5.92
22	A2M2S1	4	900:100	3	8.40	8.50	8.40	8.55	8.46	212.212	219.101	0.630	0.33	5.93
23	A2M2S2	4	900:100	3	8.50	8.45	8.60	8.65	8.53	214.772	221.711	0652	0.32	5.97
24	A2M2S3	4	900:100	3	8.55	8.55	8.65	8.50	8.45	212.886	219.811	0.614	0.33	5.93
25	A2M3S1	4	950:050	4	8.60	8.40	8.40	8.40	8.45	213.565	218.987	0.645	0.35	5.91
26	A2M3S2	4	950:050	4	8.65	8.25	8.20	8.30	8.35	214.015	220.006	0.590	0.34	5.92
27	A2M3S3	4	950:050	4	8.60	8.20	8.00	8.10	8.23	216.015	218.018	0.602	0.31	5.93
28	A3M1S1	6	850:150	2	8.35	8.35	8.30	8.35	8.35	267.446	324.656	0.906	0.36	5.93
29	A3M1S2	6	850:150	2	8.40	8.45	8.40	8.45	8.43	317.444	327.675	0.904	0.30	6.00
30	A3M1S3	6	850:150	2	8.50	8.50	8.50	8.60	8.49	317.528	321.787	0.955	0.31	6.00
31	A3M2S1	6	900:100	3	8.55	8.60	8.60	8.68	8.56	318.585	324.444	0.926	0.34	6.14
32	A3M2S2	6	900:100	3	8.80	8.75	8.80	8.75	8.73	326.158	332.566	0.978	0.28	6.30

Contd.....

Contd....

SN	Attribu.	Alm.(%)	M:P (g)	Sugar(%)	Flavor	sweetness	Col.& App.	Consistency	OAA	Chewiness	Gumminess	Springiness	TA%	pH
33	A3M2S3	6	900:100	3	8.60	8.60	8.63	8.60	8.59	326.948	322.456	0.936	0.34	5.98
34	A3M3S1	6	950:050	4	8.55	8.50	8.50	8.50	8.51	317.985	324.846	0.925	0.31	5.93
35	A3M3S2	6	950:050	4	8.45	8.40	8.40	8.40	8.41	316.583	317.846	0.913	0.37	5.95
36	A3M3S3	6	950:050	4	8.35	8.25	8.25	8.30	8.28	317.659	324.448	0.922	0.30	5.98
37	A4M1S1	8	850:150	2	8.25	8.23	7.93	8.20	8.14	308.456	312.466	0.910	0.34	5.94
38	A4M1S2	8	850:150	2	8.20	8.25	8.03	8.10	8.14	322.448	316.559	0.943	0.31	5.93
39	A4M1S3	8	850:150	2	8.15	8.22	8.20	8.05	8.16	319.945	439.444	865	0.35	5.98
40	A4M2S1	8	900:100	3	8.05	8.10	8.15	8.00	8.08	321.258	319.444	0.864	0.31	5.95
41	A4M2S2	8	900:100	3	8.00	8.10	8.10	8.00	8.05	312.544	320.422	0.898	0.37	5.94
42	A4M2S3	8	900:100	3	7.90	8.05	8.00	7.90	7.96	319.444	318.489	0.810	0.32	5.94
43	A4M3S1	8	950;050	4	7.70	8.00	8.00	7.80	7.86	314.589	320.259	0.887	0.3	5.92
44	A4M3S2	8	950:050	4	7.60	7.75	7.80	7.60	7.69	320.456	314.495	0.810	0.35	5.94
45	A4M3S3	8	950:050	4	7.50	7.50	7.75	7.50	7.61	319.005	313.058	0.843	0.29	6.10
S.E.(m)	A	-	-	-	0.017	0.030	0.018	0.014	0.013	1.576	0.192	0.004	0.008	0.008
M	-	-	-	0.013	0.023	0.014	0.011	0.010	1.221	0.149	0.003	0.006	0.006	
AxM	-	-	-	0.029	0.052	0.031	0.024	0.023	2.731	0.332	0.008	0.013	0.013	
S	-	-	-	0.013	0.023	0.014	0.011	0.010	1.221	0.149	0.003	0.006	0.006	
AxS	-	-	-	0.029	0.052	0.031	0.024	0.023	2.731	0.332	0.008	0.013	0.013	
MxS	-	-	-	0.022	0.040	0.024	0.018	0.018	2.115	0.257	0.006	0.010	0.010	
AxMxS	-	-	-	0.050	0.090	0.053	0.041	0.040	4.729	0.576	0.013	0.023	0.023	
C.D.	A	-	-	-	0.047	0.086	0.051	0.038	0.038	4.430	0.539	0.012	0.021	0.021
M	-	-	-	0.037	0.066	0.039	0.030	0.029	3.431	0.418	N/A	0.016	0.017	
AxM	-	-	-	0.082	0.149	0.088	0.066	0.066	7.673	0.934	0.021	0.037	0.037	
S	-	-	-	0.037	0.066	0.039	0.030	0.029	3.431	0.418	0.010	N/A	0.017	
AxS	-	-	-	0.082	N/A	0.088	0.066	0.066	N/A	0.934	0.021	N/A	0.037	
MxS	-	-	-	0.064	0.011	0.068	0.051	0.051	5.943	0.724	0.016	N/A	0.029	
AxMxS	-	-	-	0.142	N/A	0.075	0.115	0.114	13.290	1.618	0.037	N/A	0.064	

0.114. similar results were also found by Biswas *et al.,* (2002) and Jenkins *et al.,* (2002).

Chewiness

Interactional effect of almond levels, milk *paneer ratio and sugar* levels on chewiness of almond supplemented *Paneer kheer*

All the treatment combinations of almond, milk *paneer ratio and sugar* levels were found significant except AXC combinations. The best chewiness score (326.158) has been obtained $A_3M_2S_2$ significant with AXBXC. Significance level was 0.00047 which is less than the significance levels of 0.01. The minimum mean chewiness score of (70.888) was obtained with different treatment combinations of almond, milk *paneer ratio and sugar* levels was found also significance. The maximum mean score (70.508) was found in different combinations of control *Paneer kheer* sample.

Gumminess

Interactional effect of almond, milk *paneer ratio and sugar* levels on gumminess of almond supplemented *Paneer kheer*

The treatment combinations of almond, milk *paneer ratio and sugar* were significantly effect on gumminess of control *Paneer kheer* and almond supplemented *Paneer kheer*. The best score of gumminess (332.566) has been obtained with $A_3M_2C_2$ combination was statistically significant with AXBXC. The significance level is 0.0000, which is less than 0.01 significance levels. The minimum mean score (109.209) of gumminess was obtained with different combinations of almond, milk *paneer ratio and sugar* levels were also found significant. The maximum and minimum mean score of control *Paneer kheer* was found significant.

Springiness

Interactional effect of almond, milk *paneer ratio and sugar* levels on springiness of almond supplemented *Paneer kheer*

Treatment combinations of almond milk *paneer ratio and sugar* levels significantly influenced on springiness of almond supplemented *Paneer kheer*. The best value of springiness (0.978) has been obtained with $A_3M_2C_2$ statistically significant. all the data was found statistically significant except AXB. The significance levels of this combination are 0.0001, which has less than 0.01 significance levels. The minimum mean score (0.301) was found in different combinations of almond, mil *paneer ratio and sugar* levels.. The maximum and minimum mean score of control *Paneer kheer* was found significant.

Titratable acidity (TA)

Interactional effect of different almond, milk *paneer ratio and sugar* levels on Titratable acidity of almond supplemented *Paneer kheer*

Treatment combinations of almond, milk *paneer ratio and sugar* levels of almond supplemented *Paneer kheer* significantly influenced on TA of interaction AXB only, not other interaction data. The best score of TA (0.28) in the combination of $A_3M_2C_2$.

pH

Interactional effect of almond, milk *paneer ratio and sugar* levels on pH of almond supplemented *Paneer kheer*

Treatment combinations of almond milk *paneer ratio and sugar* levels significantly influenced the pH of almond supplemented *Paneer kheer*. The best score of pH (6.31) has been obtained with $A_3M_2C_2$ combination which was statistically found significant with AXBXC. Significance level was 0.0001, which were less than of 0.01 % level of significance. The minimum mean score (5.91) was obtained at different treatment combinations of almond, milk *paneer ratio and sugar* levels. The maximum and minimum mean score of control *Paneer kheer* was found significant.

Conclusion

The effect of different treatments was found significant for each of the parameter tested except sweetness and titratable acidity *i.e.* either physico-chemical, textural and sensory. During the entire study of this research the result revealed that maximum mean score of flavour (8.80), sweetness (8.75), colour and appearance (8.55), chewiness (326.158), gumminess (332.566), springiness (0.978), pH (6.31) was obtained when almond supplemented *Paneer kheer* was prepared with 6% almond, milk *paneer ratio* (900:100g) and sugar 3 per cent. The TA of 6% almond was found scored minimum. Mean score of overall acceptability at control condition was found to be lower (8.22) as compared to 8.63 under optimized condition. While, the minimum mean score of overall acceptability of (7.61) was found in among treatment combinations.

Acknowledgement

Firstly, I am grateful to my advisor Dr (Prof.) R. K. Pandey Former Head of Department of Animal Husbandry and Dairying, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. I would like to thank our lab technician Mr. Anand Singh for his continuous aid during entire research period. I would like to

remember all those helping hands who were directly or indirectly involved in making this research successful.

References

Biswas, P.K., R. Chakraborty and U.R. Chouduri (2002). Studies on effect of blending of Soy Milk with Cow Milk on Sensory, Textural Nutrition Qualities of Chhana Analogue. *Journal of Food Science and Technology*, **39(6):**702-704.

Bureau of Indian Standards (BIS), (1986), New Delhi.

Chakraborty, S.K., B.K. Kumbhar, S. Chakraborty and P. Yadav (2011). Influence of processing parameters on textural characteristics and overall acceptability of millet enriched biscuits using response surface methodology. *Journal Food Science Technology*, **48(2):** 167-174.

Chetana, R., B. Manohar and S.R. Reddy (2004). Process optimization of gulabjamun, an Indian traditional sweet, using sugar substitute. *Europe Food Science and Technology*, **219:** 386-392.

Desai., H.K. (2007). Sensory profile of traditional dairy products. In: Gupta S, editor. Dairy India. New

Gil, K., The health benefits of almonds, (2017). Newsletter, Medical New Today.

Indian Council of Medical Research (ICMR), New Delhi.

Indian Council of Agriculture Research (ICAR). Handbook of Dairy Chemistry (1972).

IS 8140 – 1976 (Reaffirmed 2002). Guide for Selection of Panel for Sensory Evaluation of Food and Beverages.

Jenkins, D.J.A., C.W.C. Kendall, C.J.C. Jackson, P.W. Connelly, T. Parker and D. Faulkner *et al.* (2002). Effects of high and low isoflavone soy foods on blood lipids, oxidized LDL, homocysteine and blood pressure in hyperlipidemic men and women. *American Journal of Clinical Nutrition*, **76(2):** 365-372.

Karan., G. (2017). The health benefits of almonds, Newsletter, Medical New Today.

National Dairy Development Board (NDDB), Anand Gujrat 2017-18.

Prevention of the Food Adulteration (PFA), 1976.

Research and Markets.com's (2018). "Paneer Market: Global Industry Trends, Share, Size, Growth, Opportunity and Forecast 2018-2023".

Sindhu, J.S. (1996). Suitability of buffalo milk for products manufacturing. *Indian Dairyman*, **48:** 41–47.

Singh., S. and S.K. Kanawjia (1988). Development of manufacturing technique for *paneer* from cow milk. *Indian J Dairy Sci.*, **41:** 322–325.

Vishweshwaraiah., L and C.P. Anantakrishnan (1985). A study on technological aspects of preparing *paneer* from cow's milk. *Asian J. Dairy Res.*, **4 :** 171–176.