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Studies on sensory and physico-chemical properties of lassi blended with pineapple powder (*Ananas comosus*)

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Abstract
The present experiment was conducted at Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur (VNMKV) during 2024-25. The experiment was undertaken to explore the possibilities of utilizing Pineapple powder in *lassi* production to improve sensory and physico-chemical properties of *lassi*. The obtained product was subject for standardize the procedure, sensory and physico-chemical properties, shelf life and cost of production. The present study was carried out with for four treatments including control T_1 and *Lassi* prepared from buffalo milk with different proportion of Pineapple Powder. i.e 0 percent,3 percent, 6 percent, 9 percent in Treatment T_1, T_2, T_3, and T_4 respectively. The mean score of Colour and appearance of *lassi* was highest in T_4 (8.75) and lowest in T_1 (7.50). The mean score for flavour was highest in T_3 (8.75) and lowest in T_4 (8.00), average score for taste was highest in T_3 (8.75) and lowest in T_4 (8.00). The mean score for consistency was highest in T_3 (8.75) and lowest in T_4 (8.00). Treatment T_3 (8.75) showed highest overall acceptability score over other Treatments. Its concluded that, acceptable quality *Lassi* can be prepared by adding T_3 (6 percent) Pineapple powder.

Keywords: Buffalo milk, *lassi*, pineapple powder, dahi, sensory and physico-chemical properties

Introduction

India remains globally the top milk producer, India has cemented its position as the world's dairy powerhouse the nations dairy sector has charted an impressive Compound Annual Growth Rate (CAGR) OF 4.97% between 2018-19 and 2023-24, Culminating in a historic milestone of 239.30 million tonnes in 2023-24. According to the FAO, India proudly holds its position as the global leader in milk production behind the USA, Pakistan, China, and Brazil,

Lassi is a traditionally fermented milk beverage having its origin in India and is popular in south Asia in different varieties. It is popular for its pleasant taste, cooling and thirst quenching properties and therapeutic value, it has creamy consistency, sweetish rich aroma and mild to acidic flavour, which makes the product refreshingly palatable, (Patel *et al*. 2020) [10], it is ready to serve beverage that occupies prominent place in the Indian diet. it is blend of *dahi*, water, and spices or fruits are added (Sudheendra *et al*., 94-97) [7]. *Lassi* is produced by fermenting milk with a specific bacterial culture, typically lactic streptococci, in heated whole or skimmed milk, and then sweetened with sugar (Nichal *et al*., 2022) [3].

Pineapple juice is rich in ascorbic acid, a potent antioxidant that helps combat bacterial and viral infections and enhances iron absorption. Pineapple is also an excellent source of essential minerals like magnesium, which is crucial for bone formation and enzyme activation. Additionally, pineapple contains copper and other trace minerals that aid in iron absorption, blood pressure regulation, and heart rate management. Pineapple powder is often used to prepare various products, such as jam and cheese. (Joy.*et al*.2016). Pineapple contains moisture 2.0%, protein 12%, fat 10%, ash 1.57%, crude fiber 2.23%, carbohydrate 74%, Thiamine 2 mg, Riboflavin 0.375 mg, Niacin 2.27 mg, Pyrodoxine 67.5 mg. (Tabassun *et al*., 2017) [11].

Materials and Methods

The *lassi* was prepared as per the procedure given by Kedaree *et al*. (2021) [2]. Buffalo milk (3% Fat and 6% Solid Not Fat) was heated at 90 °C for 10 min. then cooled at 37 °C and inoculated with starter culture @ 2 percent and incubated at 35 °C in incubator for 8 hours. Prepared dahi was then broken and added with 15 percent sugar plus 20 percent water on weight basis and Pineapple powder as per treatment combination and blended well with hand blender and stored at refrigerated temperature 7±2 °C.

Collection of buffalo milk
↓
Pasteurization at 90 °C for 10 minutes
↓
Cooled at room temperature (35 °C or 37 °C)
↓
Inoculation of starter culture at rate of 2 percent at 35 °C (NCDC-167)
↓
Inoculation at room temperature for 8 hrs at 35 °C for setting of *dahi*
↓
Dahi (acidity-0.75percent)
↓
Breaking of coagulam
↓
Addition of chilled water, sugar and pineapple powder
↓
Blending
↓
Filling in containers
↓
Storage Refrigeration (7+2 °C)

Fig 2: Flow chart for Preparation of *lassi* blended with pineapple powder (*Ananas Comosus*)

Methods

Preparation of *lassi* blended with pineapple powder

Treatment combinations

For preparation of *lassi* by addition of pineapple powder, the treatment combinations was evaluated on weight basis as per given below-

T_1-100 parts of curd (Control)
T_2-97 parts of curd + 03 parts pineapple powder.
T_3-94 parts of curd + 06 parts of pineapple powder.
T_4-91 parts of curd + 09 parts of pineapple powder.
T_5 percent sugar was added in control as well as treated sample

Sensory Evaluation

Sensory evaluation of *lassi* samples were carried out by a judges of semi-expert panel by using 9-point hedonic scale, Flavour, consistency, Colour and appearance and Overall acceptability sensory parameters were included in the study.

Physico-chemical evaluation

Physico-chemical parameters of *lassi* samples such as Acidity, pH, Fat, Protein, Moisture, Total solids, Ash, such as was studied and obtained data were analysed by using Completely Randomized Block Design (CRD).

Fat was determined by using Gerber method as described in IS:1224 (Part II) (1977). Protein was determined by using the Lowry method (1951). Ash was determined by using muffle furnance as described in IS: SP (Part XI) 1981.Acidity was determined by method outlined in IS 1479 (Part-I) (1960). Moisture was determined by using method described in IS: SP (Part XI) 1981. Total solids was determined by using method described in IS: SP (Part XI) 1981. pH was determined by using digital pH meter (335).

Statistical design

The data was analysed statistically using a Completely Randomized Design (CRD) as per Panse and Sukhatme (1967). The significance of the result was evaluated on the basis of the critical difference in all four replications.

Cost estimation of manufacturing Lassi

The cost estimation (Rs./Litre) of the product was worked out by taking into account the prevailing market rates of the ingredients used for preparation of pineapple powder lassi.

Results and Discussion

The results of the present study as well as relevant discussions have been presented under following Table 1 to 3.

Quality of standardized milk

The flavour appearance and colour of the milk sample was normal. The composition of buffalo milk is Moisture 85 percent, Fat 6.00 percent, Protein 3.50 percent, SNF 9.00, Lactose 4.50, Total solids 15 percent, Acidity 0.14 percent.

Quality of pineapple powder

The Fat (%), Moisture (%), Protein (%), Ash (%), Acidity (%), Total solids (%), of pineapple powder were 0.14, 5.00, 0.44, 0.3, 0.75, 92 respectively.

Sensory evaluation of Lassi

The score of colour & appearance, Flavour, Taste, Consistency, overall acceptability, In table 2. The highest sensory evaluation shown for colour and appearance, Flavour, Taste, consistency, overall acceptability is for lassi prepared by using 6 percent pineapple powder.

Sensory evaluation of Lassi

Sensory evaluation of control and *lassi* blended with pineapple powder was carried out by semi-trained panel of 5 judges using 9-point hedonic scale. The sensory attributes such as colour and appearance, flavour, taste, consistency and overall acceptability was studied and data obtained were analysed by using Completely Randomized Block Design (CRD). The scores given by judges for different sensory parameters were recorded and subsequently discussed as follows.

Colour and appearance score of *lassi* blended with pineapple powder

The mean score for colour and appearance of *lassi* blended with pineapple powder are given in table

Table 1: Colour and appearance score of *lassi* blended with pineapple powder

Treatment	Replication				Mean
	R_1	R_2	R_3	R_4	
T_1	7.00	8.00	7.00	8.00	7.50
T_2	7.00	8.00	8.00	9.00	8.00
T_3	7.00	8.00	8.00	9.00	8.00
T_4	8.00	9.00	9.00	9.00	8.75
S.E.±0.3461	C.D. at 5% 1.066				

The values differ non-significantly (p>0.05)

The colour and appearance score for control and *lassi* blended with pineapple powder T_2, T_3 and T_4 are 7.50, 8.00, 8.00, 8.75, respectively.

The results indicated that addition of pineapple powder in *lassi* increased colour and appearance score non-significantly towards higher level of addition of pineapple powder in *lassi*. The colour and appearance score for T_4 (8.75) was highest and differ non significantly from T_1 (7.50), T_2 (8.00), T_3 (8.00).

The non-significant difference in colour and appearance score among the treatment and control was due to yellowish colour of pineapple powder. However, at higher concentration T_3 and T_4 colour and appearance was appealing due to yellowish colour of *lassi*.

The results of present study are similar with Pawar *et al*. (2024) [4] who reported that addition of Apple powder in *lassi* at 0, 2, 4, 6% increased colour and appearance score of T_4 8.75 as compared to control (7.50).

Flavour score of *lassi* blended with pineapple powder

The mean Flavour score for *lassi* blended with pineapple powder are presented in Table.

Table 2: Flavour score of *lassi* blended with pineapple powder

Treatment	Replication				Mean
	R1	**R2**	**R3**	**R4**	
T_1	7.00	7.00	9.00	8.00	7.75
T_2	8.00	7.00	8.00	8.00	7.75
T_3	8.00	9.00	9.00	9.00	8.75
T_4	8.00	8.00	8.00	9.00	8.25
S.E.±0.3227	C.D. at 5% 0.9944				

The values differ non significantly (p>0.05)

The flavour score for control (T_1) and *lassi* blended with pineapple powder T_2, T_3, and T_4 are 7.75,7.75, 8.75, 8.25, respectively.

The results indicated that addition of pineapple powder in *lassi* increased flavour score non-significantly towards higher level of addition of pineapple powder in *lassi*.

The results of present study are similar with Bagal *et al*. (2016) [5] who reported that addition of papaya pulp in *lassi* at 4, 8, 12, percent increased flavour score at 8 percent level of papaya pulp (37.38) than control T_0 (35.87).

Taste score of *lassi* blended with pineapple powder

The mean taste score for *lassi* blended with pineapple powder are given in

Table 3: Taste score of *lassi* blended with pineapple powder

Treatment	Replication				Mean
	R1	**R2**	**R3**	**R4**	
T_1	7.00	8.00	8.00	7.00	7.50
T_2	8.00	8.00	8.00	8.00	8.00
T_3	9.00	9.00	8.00	9.00	8.75
T_4	7.00	8.00	9.00	9.00	8.25
S.E.±0.306	C.D. at 5% 0.9434				

The values differ non-significantly (p>0.05)

The taste score for control (T_1) and *lassi* blended with pineapple powder T_2, T_3 and T_4 are 7.50, 8.00, 8.75, 8.25, respectively.

The results indicated that addition of pineapple powder in *lassi* increased taste score non-significantly up to T_3 then decreased. The taste score for T_3 (8.75) was highest and differ non-significantly from T_1, T_2, as well as T_4.

Decrease in taste score of *lassi* at higher concentration of pineapple powder was due increase in acidity.

The results of present study are in contract with results obtained by Pawar *et al*. (2024) [4] who reported that addition of apple powder in *lassi* at 2, 4, 6, percent significantly increased taste score from T_1 (7.75) to T_3 (8.75) and further decreased from T_4 (8.25).

Consistency score of *lassi* blended with pineapple powder

The mean consistency score for *lassi* blended with pineapple powder are presented in table

Table 4: Consistency score of *lassi* blended with pineapple powder

Treatment	Replication				Mean
	R1	**R2**	**R3**	**R4**	
T_1	7.00	8.00	8.00	7.00	7.50
T_2	7.00	8.00	9.00	8.00	8.00
T_3	8.00	9.00	9.00	9.00	8.75
T_4	8.00	8.00	8.00	8.00	8.00
S.E.±0.2795	C.D. at 5% 0.8612				

The values differ non-significantly (p>0.05)

The consistency score for control (T_1) and *lassi* blended with pineapple powder T_2, T_3, and T_4 are 7.50, 8.00, 8.75, 8.00 respectively.

The results indicated that addition of pineapple powder in *lassi* increased consistency score non-significantly towards higher level of addition of pineapple powder in *lassi*. However, addition of pineapple powder at 6 percent level increase consistency significantly than control then decreases in T_4 (8.00).

The results of present study are contract with results Bagal *et al*. (2016) [5] who reported that addition of papaya pulp in *lassi* at 4, 8, 12 increased in consistency score for 8 percent (8.75) than control (7.50) then decreased up to T_4 (8.00).

Overall acceptability score of *lassi* blended with pineapple powder

The mean overall acceptability score of *lassi* blended with pineapple powder are given in Table

Table 5: Overall acceptability score of *lassi* blended with pineapple powder

Treatment	Replication				Mean
	R1	**R2**	**R3**	**R4**	
T_1	8.00	7.00	9.00	8.00	8.00
T_2	8.00	8.00	8.00	8.00	8.00
T_3	8.00	9.00	9.00	9.00	8.75
T_4	8.00	8.00	9.00	9.00	8.50
S.E.±0.2795	C.D. at 5% 0.8612				

The values differ non-significantly (p>0.05)

The overall acceptability score for control and *lassi* blended with pineapple powder for treatments T_2, T_3 and T_4 are 8.00, 8.00, 8.75, 8.50 respectively.

The results indicated that addition of pineapple powder in *lassi* increased overall acceptability score up to treatment T_3 further decreased. The overall acceptability score was highest for T_3 (8.75) and differ non-significantly from T_1 and T_2. However, overall acceptability score of T_4 was lowest among all treatment as well as control. Decrease in overall acceptability was due to increase in acidity of *lassi*.

The findings of present study are similar with results of Pawar *et al*. (2024) [4] who reported that addition of pineapple powder in *lassi* increased overall acceptability score up to treatment T_3 (8.75) and differ significantly from other treatments.

Physico-Chemical evaluation of *Lassi*

Acidity of *lassi* blended with pineapple powder

The values for percent acidity of *lassi* blended with pineapple powder as given in table

Table 6: Acidity of *lassi* blended with pineapple powder (percent)

Treatment	Replication				Mean
	R_1	R_2	R_3	R_4	
T_1	0.69	0.65	0.64	0.63	0.65
T_2	0.73	0.72	0.73	0.74	0.73
T_3	0.76	0.76	0.76	0.77	0.76
T_4	0.80	0.79	0.79	0.79	0.79
S.E.±0.0071	C.D. at 5% 0.0219				

The values with different superscripts differ significantly ($p<0.05$)

The mean value of percent acidity for control (T_1) and *lassi* blended with pineapple powder T_1, T_2, T_3, and T_4 are 0.65, 0.73, 0.76, 0.79 percent respectively. The percent acidity of control sample was significantly lower than all treatments. Between the treatment percent acidity of T_2 and T_3 does not differ significantly from each other, However percent acidity value of T_4 was higher among all treatments and differ significantly.

The significantly increased in percent acidity of *lassi* with pineapple powder, was due to higher 0.75 percent acidity of pineapple powder.

The results of present study are in contract with the Mane *et.al*. (2022) [8] who reported that addition of jamun powder in *lassi* at 0.5%, 1%, 1.5% percent increased acidityfrom0.73,0.85,0.96,1.06.

pH of *lassi* blended with pineapple powder

The values for pH of *lassi* blended with pineapple powder are given in table

Table 7: pH of *lassi* blended with pineapple powder

Treatment	Replication				Mean
	R_1	R_2	R_3	R_4	
T_1	5.80	5.75	5.76	5.73	5.76
T_2	5.76	5.71	5.72	5.69	5.72
T_3	5.68	5.66	5.69	5.63	5.67
T_4	5.57	5.15	5.53	5.54	5.54
S.E.±0.0138	C.D. at 5% 0.0426				

The values with different superscripts differ significantly ($p<0.05$)

The pH value of T_1, T_2, T_3 and T_4 were 5.76, 5.72, 5.67, 5.54, respectively. The pH of control sample was significantly higher than all treatments. Between the treatment pH value decreased towards increase in percent addition of pineapple powder. However, pH value of T_3 and T_4 does not differ significantly from each other, pH of T_1 was higher between all treatments and differ significantly.

The significantly decrease in pH of *lassi* with pineapple powder was due to increase in acidity.

The results of present study are in contract with Mane *et al*. (2022) [5] who reported that addition of jamun powder in *lassi* at 0.5, 1, 1.5 percent decreased pH from 4.29, 4.21, 4.18, 4.15,

The results obtained in present study are contradictory with the results reported by Upadhyay *et al*. (2017) [9] who noted that the pH of *lassi* sample blended with 10,20, and 30 percent carrot juice decreased pH from 4.43, 3.98.

Fat content of *lassi* blended with pineapple powder

The fat content of *lassi* blended with pineapple powder are given in table

Table 8: Fat content of *lassi* blended with pineapple powder (percent)

Treatment	Replication				Mean
	R_1	R_2	R_3	R_4	
T_1	6.27	6.24	6.28	6.25	6.26
T_2	6.24	6.23	6.21	6.24	6.23
T_3	6.21	6.19	6.16	6.21	6.19
T_4	6.18	6.15	6.12	6.12	6.14
S.E.±0.0109	C.D. at 5% 0.0337				

The values with different superscripts differ significantly ($p<0.05$)

The percent fat content of control T_1 and *lassi* blended with pineapple powder T_2 and T_4 was 6.26, 6.23, 6.19, 6.14 respectively. The fat content of control sample was significantly higher than all treatments. Between the treatment fat content decreased significantly toward higher level of addition of pineapple powder.

The significantly decreased in fat content of *lassi* with pineapple powder was due to lower fat (0.14 percent) content in pineapple powder.

The results of present study are similar with Mane *et al*. (2022) [8] reported that addition of jamun powder in *lassi* at 0.5, 1, 1.5 percent significantly decreased in fat content from 3.25, 3.16, 3.04, 2.95 in treated product respectively.

Protein content of *lassi* blended with pineapple powder

The values of protein content of *lassi* blended with pineapple powder are presented in table

Table 9: Protein content of *lassi* blended with pineapple powder (percent)

Treatment	Replication				Mean
	R_1	R_2	R_3	R_4	
T_1	2.10	2.12	2.12	2.15	2.12
T_2	2.08	2.06	2.09	2.10	2.08
T_3	2.06	2.04	2.08	2.06	2.06
T_4	2.02	2.04	2.06	2.04	2.04
S.E.±0.0088	C.D. at 5% 0.0272				

The values with different superscripts differ significantly ($p<0.05$)

The mean value of protein content from control (T_1) and *lassi* blended with pineapple powder T_2, T_3, and T4 are 2.12, 2.08, 2.06, 2.04, percent, respectively. The protein content of control was lower than all treatments and differ significantly. However, T_1 and T_2 does not differ significantly from each other. Among the treatment protein content increased significantly towards higher level of addition of pineapple powder.

The significantly decreased in protein content of *lassi* blended with pineapple powder was due to protein content (0.44 percent) in pineapple powder.

The results of present study are in contract with the results of Upadhyay *et al*. (2017) [9] who reported that addition of

Carrot juice in *lassi* at 0, 10, 20, 30 percent decreased protein from 3.53, 3.23, 3.00, 2.82.

Moisture content of *lassi* blended with pineapple powder

The moisture content of *lassi* blended with pineapple powder is presented in Table

Table 10: Moisture content of *lassi* blended with pineapple powder (percent)

Treatment	Replication				Mean
	R_1	R_2	R_3	R_4	
T_1	76.84	76.83	76.83	76.84	76.84
T_2	76.81	76.82	76.83	76.93	76.83
T_3	76.86	76.92	76.92	75.92	75.42
T_4	76.96	76.86	75.94	75.93	74.17
S.E.±0.0192	S.E.±0.0192				

The values with different superscripts differ significantly ($p<0.05$)

The mean value of moisture content for control (T_1) and *lassi* blended with pineapple powder T_2, T_3, T_4 are 76.84, 76.83, 75.42, 74.17 percent, respectively. The moisture content of control sample was significantly higher than all treatments. Among treatment moisture content of T_2, T_3 and T_4 differ significantly from each other.

The significant decrease in moisture content of *lassi* towards higher level of pineapple powder could be due to hygroscopic nature of pineapple powder.

The results of present study are in contract with the results of Mane *et al*. (2022) [8] who reported that addition of jamun powder in *lassi* at 0, 0.5, 1, 1.5 percent decreased moisture from 76.99, 75.78, 74.28, 73.01.

Total solids content of *lassi* blended with pineapple powder

The total solids content of *lassi* blended with pineapple powder are presented in Table

Table 11: Total solids content of *lassi* blended with pineapple powder (percent)

Treatment	Replication				Mean
	R_1	R_2	R_3	R_4	
T_1	23.04	23.14	23.06	23.07	23.08
T_2	23.14	23.10	23.06	23.08	23.10
T_3	24.19	23.18	23.17	23.07	23.15
T_4	26.16	23.17	23.17	23.15	24.16
S.E.±0.0197	C.D. at 5% 0.0608				

The values with different superscripts differ significantly ($p<0.05$)

The mean value of total solid content for control (T_1) and *lassi* blended with pineapple powder T_2, T_3 and T_4 are 23.08, 23.10, 23.15, 24.16, percent, respectively. The total solid content of control sample was significantly lower than all treatments. Between treatment total solid content increased significantly toward higher level of addition of pineapple powder.

The significantly increase in total solid content of *lassi* with pineapple powder was due to higher total solid (92%) content in pineapple powder.

The results of present study are in contract with the results of Pawar *et al*. (2024) [4] was reported that addition of apple powder in *lassi* at 0, 2, 4, 6 percent, respectively increased total solid content from 24.42, 25.77, 26.06, 26.70 in treated product significantly.

Ash content of *lassi* blended with pineapple powder

The ash content of *lassi* blended with pineapple powder are presented in table

Table 12: Ash content of *lassi* blended with pineapple powder (percent)

Treatment	Replication				Mean
	R_1	R_2	R_3	R_4	
T_1	1.03	1.02	1.02	1.02	1.02^b
T_2	1.03	1.02	1.02	1.06	1.03^b
T_3	1.05	1.09	1.05	1.08	1.07^a
T_4	1.09	1.08	1.10	1.04	1.08^a
S.E.±0.0096	C.D. at 5% 0.0298				

The values with different superscripts differ significantly ($p<0.05$)

The mean value of ash content for control (T_1) and *lassi* blended with pineapple powder T_2, T_3, T_4, are 1.02, 1.03, 1.07 and 1.08 percent, respectively. The ash content of control sample was significantly lower than all treatments. Between treatment ash content increased significantly toward higher level of addition of pineapple powder.

The significantly increased in ash content of *lassi* blended with pineapple powder was due to decrease in moisture content in *lassi* blended with pineapple powder.

The above results are in contract with the results recorded by Pawar *et al*. (2024) [4] and Kedaree *et al*. (2021) [2] reported that addition of apple powder in *lassi* at 0, 2, 4, 6 and 2, 4, 6, 8, percent, respectively increased ash content from 1.17, 1.27, 1.36, 1.47 and 1.14 to 1.33 respectively.

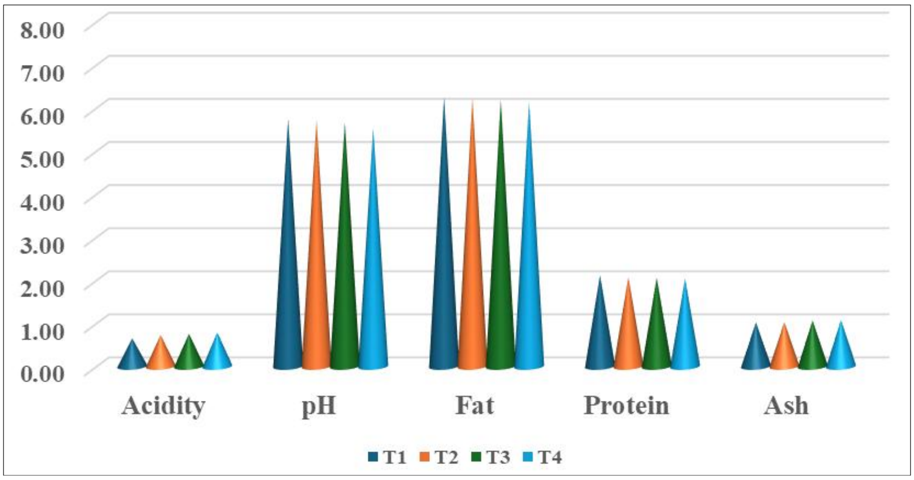

Fig 1: Physico-chemical properties of *lassi* blended with pineapple powder

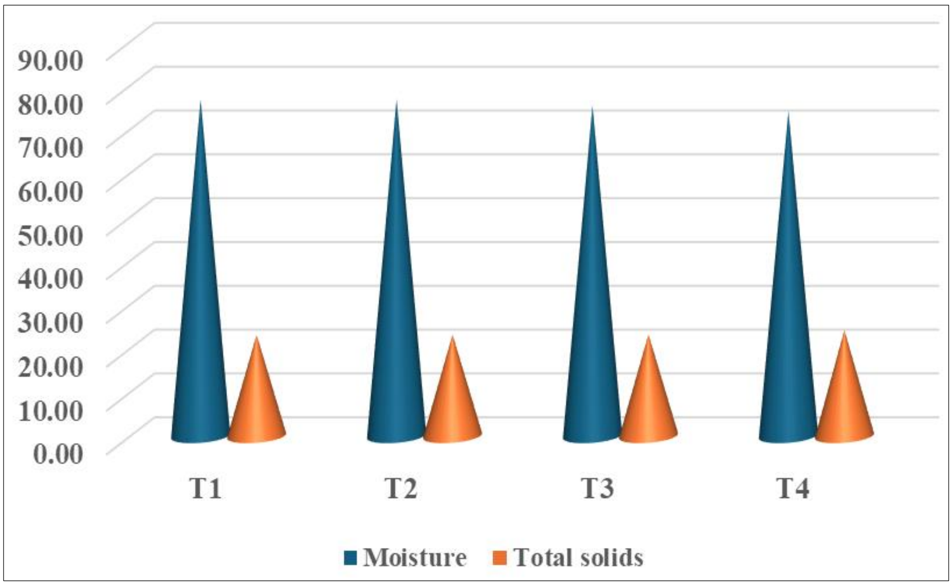

Fig 2: Physico-chemical properties of *lassi* blended with pineapple powder

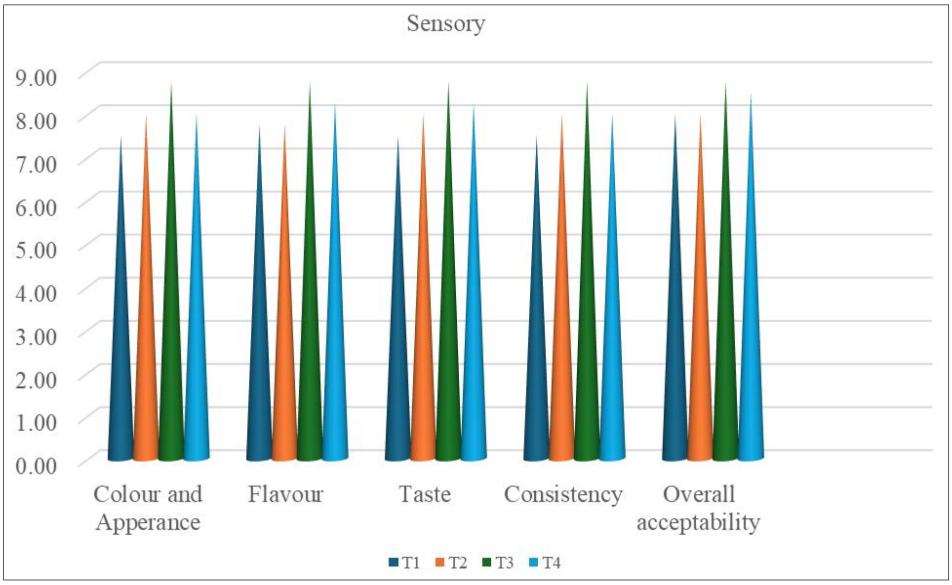

Fig 3: Sensory properties of *lassi* blended with pineapple powder

Conclusion

It may be conclude that good quality, nutritional enriched and value added lassi with more acceptability can be prepared by addition of pineapple powder. It is suitable among all group of consumer.

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