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Standardisation of Recipe with Value Addition for Mango Candy (*Mangifera indica* Linn)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present experiment was carried out during June to September, 2022 in Post- Harvest laboratory of Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in (CRD) completely randomized design, with nine treatments which were replicated thrice. The treatments were T_0: Control (standard recipe), T_1: Mint syrup (0.5%), T_2: Mint syrup (1.0%), T_3: Tulsi syrup (0.5%), T_4: Tulsi syrup (1.0%), T_5: Lemongrass syrup (0.5%), T_6: Lemongrass syrup (1.0%), T_7: Cinnamon syrup (0.5%) T_8:Mint syrup(0.5%)+Tulsi syrup(0.5%)+Lemongrass syrup(0.5%). The Mango candy was stored for 60 days at ambient temperature. From the present investigation it is found that treatment T_2 is superior in respect of the physio-chemical parameters like total soluble

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solids, titratable acidity, ascorbic acid, total sugar. Treatment T_2 is also found superior in organoleptic scoring of Mango candy. In terms of benefit cost ratio the highest net return, was also found in T_2 and minimum was recorded in T_4 in all the parameters.

Keywords: Mango; candy physico-chemical properties; economics.

1. INTRODUCTION

Mango belongs to the genus *Mangifera* of the family Anacardiaceae. The genus *Mangifera* contains several species that bear edible fruit. Most of the fruit trees that are commonly known as mangoes belong to the species *Mangifera indica*. The other edible *Mangifera* species generally have lower quality fruit and are commonly referred to as wild mangoes. Mango has become naturalized and adapted throughout the tropics and subtropics. Much of the spread and naturalization has occurred in conjunction with the spread of human population, and as such, the mango plays an important role in the diet and cuisine of many diverse cultures. There are over 1000 named mango varieties throughout the world, which is a testament to their value to humankind. Mango is a common garden tree throughout the tropics. When ripe, this delicious dessert fruit is particularly high in vitamin A. The fruit is also eaten green, processed into pickles, pulps, jams, and chutneys, and is frozen or dried. The fruit is also an important source of sustenance for birds, bats, insects, and mammals. Although grown widely, mangoes prefer a warm, frost-free climate with a well-defined winter dry season. Rain and high humidity during flowering and fruit development reduces fruit yields. The tree generally flowers in mid- to late winter, with fruit maturing in the early to mid-summer months. Mango trees are usually between 3 to 10 m (10–33 ft) tall but can reach up to 30 m (100 ft) in some forest situations. The canopy is evergreen with a generally spreading habit. The heavy canopy of the mango is a source of shelter and shade for both animals and human.

Among the other processed products, fruit bar is also popular which is thick, pleasant and dried product made from fruit pulp having greater nutritional value than the fresh fruits because all nutrients are present in concentrated form and therefore, they become a convenience food assortment to get health benefits of fruits (Wahane et al., 2019). Traditionally mango bars have been prepared from unmarketable surplus and indige nous variety of mango which otherwise do not find place and price in the market. Blending with ingredients like sugar, milk powder and gelatin may impart enhanced physico- chemical properties and increased nutritive value of processed sweet fruit based products from raw mango and to evaluate storage stability of the candy. Fruit based confectionary items are considered as a popular segment of world market. However, most of the confectionary products are prepared by artificial flavor and sometimes small concentration of fruits. No attempts so far have been made to utilize raw mango for processing into osmotically dehydrated value added product and disposal as a source of income for the farmers. Such confectionery products due to their sweet taste and flavour enjoy a wide acceptance. With increasing awareness of the food value and dietary role of various food constituents, people are now highly discriminative in selecting products. The market tendency is to select those products prepared from natural ingredients. Fruit toffees contain nutrients like vitamins and minerals present in the original fruit and are nutritionally superior to those prepared from sugar or syrup. The osmo-dried or fruit candies are popular and highly acceptable confectionery products liked by almost all age groups as a snack for quick energy. They can be better utilized as a vehicle to promote consumption and utilization of such local fruits that are produced in glut and have quite limited shelf life. The aim of the present work was focused on standardizing the protocol for preparation of fruit candy.

2. MATERIALS AND METHODS

The present investigation entitled **"**Standardisation of recipe with value addition for Mango candy (*Mangifera indica*)" was carried out at Post-Harvest lab, Department of Horticulture, SHUATS, Naini Agricultural Institute, Prayagraj in the year 2022-2023.

The treatments were T_0: Control, $T_{1:}$ Mint syrup (0.5%), $T_{2:}$ Mint syrup (1.0%), T_3: Tulsi syrup (0.5%), T_4: Tulsi syrup (1.0%), T_5: Lemongrass syrup (0.5%), T_6: Lemongrass syrup (1.0%), T_7: Cinnamon syrup (0.5%) T_8: Mint syrup (0.5%) + Tulsi syrup (0.5%) + Lemongrass syrup (0.5%).

3. RESULTS AND DISCUSSION

TSS of Mango candy was observed to increase continuously up to the end of research under ambient storage conditions. At beginning of storage maximum total soluble solids 77.93 ^{0}Brix was observed in T2 [Mint syrup (1.0%)] followed by 76.97 ^{0}Brix observed in T5 [Lemongrass syrup (0.5%)] and minimum 73.24 ^{0}Brix in T0 [Control]. At 60 days after storage maximum TSS recorded is 80.86 ^{0}Brix in T2 [Mint syrup (1.0%)] followed by 79.80 ^{0}Brix observed in T5 [Lemongrass syrup (0.5%)] and minimum 76.02 ^{0}Brix in T0 [Control]. Increase in TSS during storage can be due to conversion of polysaccharides into sugars during hydrolysis process. Therefore, TSS found to increase slightly with increase in storage period. Similar findings reported by Manivsagan (2011) in karonda candy and by Navitha and Mishra (2018) in Ber candy.

Acidity of Mango candy was observed to decrease continuously up to the end of research under ambient storage conditions. At beginning of storage maximum acidity 1.00% was observed in T2 [Mint syrup (1.0%)] followed by 0.99 % was observed in T7 [Cinnamon syrup (1.0%)] and minimum 0.92% in T5 [Lemongrass syrup(0.5%)]. At 60 days after storage maximum acidity recorded is 0.94% in T2 [Mint syrup (1.0%)] followed by 0.93% observed in T1 [Mint syrup (0.5%)] and minimum 0.80% in T5 [Lemongrass syrup (0.5%)]. The decrease in acidity (%) in Mango candy during storage can be the result of chemical interaction between Mango candy constituents induced by temperature and action of enzyme. Similar results were reported by Neelesh (2014) in papaya candy and Navitha and Mishra (2018) in Mango candy.

Ascorbic acid (mg/100g) of Mango candy was observed to decrease continuously up to the end of research under ambient storage conditions. At beginning of storage maximum Ascorbic acid 32.07 mg/100g was observed in T2 [Mint syrup(1.0%)] followed by 31.99 mg/100g observed in T4 [Tulsi syrup (1.0%)] and minimum is 29.94 mg/100g in T5 [Lemongrass syrup(0.5%)]. At 60 days after storage maximum Ascorbic acid recorded is 27.19 mg/100g in T2 [Mint syrup (1.0%)] followed by 26.92 mg/100g observed in T4 [Tulsi syrup (1.0%)] and minimum 25.60 mg/100g in T5 [Lemongrass syrup (0.5%)]. Ascorbic acid in any food commodity plays important role in deciding its shelf life. Similar results were reported by Daisy and Gehlot [1] in Aonla preserve and Neelesh (2014) in papaya candy.

Reducing sugar (%) of Mango candy was observed to increase continuously up to the end of research under ambient storage conditions. At beginning of storage maximum Reducing sugar 24.49% was observed in T2 [Mint syrup (1.0%)] followed by 24.45% observed in T4 [Tulsi syrup (1.0%)] and minimum is 23.70% in T0 [Control]. At 60 days after storage maximum Reducing sugar recorded is 26.28% in T2 [Mint syrup (1.0%)] followed by 26.05% observed in T7 [Cinnamon syrup (1.0%)] and minimum 25.18% in T5 [Lemongrass syrup (0.5%)]. Reducing sugar in any food commodity plays important role in deciding its shelf life. Usually, high sugar content makes the moisture unavailable for the growth of microorganisms, thus improves the shelf life of food. Similar results were reported by Daisy and Gehlot [1] in Aonla preserve.

Non-reducing sugar (%) of Mango candy was observed to increase continuously up to the end of research under ambient storage conditions. At beginning of storage maximum Non- reducing sugar 33.34% was observed in T2 [Mint syrup (1.0%)] followed by 33.28% observed in T4 [Tulsi syrup (1.0%)] and minimum is 30.51% in T0[Control]. At 60 days after storage maximum Non-reducing sugar recorded is 35.59% in T2 [Mint syrup (1.0%)] followed by 35.58% observed in T3 [Tulsi syrup (0.5%)] and minimum 33.59% in T0[Control].

Non-reducing sugar in any food commodity plays important role in deciding its shelf life. Usually, high sugar content makes the moisture unavailable for the growth of microorganisms, thus improves the shelf life of food. Similar results were reported by Daisy and Gehlot [1] in Aonla preserve.

Total sugar (%) of Mango candy was observed to increase continuously up to the end of research under ambient storage conditions. At beginning of storage maximum Total sugar 57.83% was observed in T2 [Mint syrup (1.0%)] followed by 57.80% observed in T8 [Mint syrup (0.5%) +Tulsi syrup (0.5%) + Lemongrass syrup (0.5%)] and minimum is 54.21% in T0[Control]. At 60 days after storage maximum Total sugar recorded is 61.87% in T2 [Mint syrup (1.0%)] followed by 61.85% observed in T8 [Mint syrup (0.5%) +Tulsi syrup (0.5%) + Lemongrass syrup (0.5%)] and minimum 59.04% in T0 [Control]. Total sugar in any food commodity plays important role in deciding its shelf life. Usually,

high sugar content makes the moisture unavailable for the growth of microorganisms, thus improves the shelf life of food. Similar results were reported by Krishnaveni et al. (2001) in jack fruit RTS, Jain et al. [2] in papaya cubes.

Colour and Appearance (sensory score) of Mango candy was observed to decrease continuously up to the end of research under ambient storage conditions. At beginning of storage best colour and appearance (sensory score) 8.98 was observed in T2 [Mint syrup (1.0%)] followed by 8.93 observed in T1 [Mint syrup(0.5%)] and lowest 8.43 in T3 [Tulsi syrup (0.5%)]. At 60 days after storage best Colour and Appearance (sensory score) recorded is 8.92 in T2 [Mint syrup (1.0%)] followed by 8.79 observed in T1 [Mint syrup(0.5%)] and lowest is 8.10 in T3 [Tulsi syrup (0.5%)]. Colour and Appearance in any food commodity plays important role in deciding its market value. Colour is an attribute of food quality and loss of colour by osmotic dehydration process is one of the most significant changes. Similar results were reported by Heredia (2004) and Singh et al., (2012) in Ber candy.

Flavour (sensory score) of Mango candy was observed to decrease continuously up to the end of research under ambient storage conditions. At beginning of storage best flavour (sensory score) 8.54 was observed in T2 [Mint syrup (1.0%)] followed by 8.50 observed in T1 [Mint syrup(0.5%)] and lowest 8.42 in T5 [Lemongrass syrup (0.5%)]. At 60 days after storage best flavour (sensory score) recorded is 7.86 in T2 [Mint syrup (1.0%)] followed by 7.75 observed in T8 [Mint syrup (0.5%) +Tulsi syrup (0.5%) + Lemongrass syrup (0.5%)] and lowest is 7.31 in T5 [Lemongrass syrup (0.5%)]. Flavour in any food commodity plays important role in deciding its market value. This might be due to degradation of volatile substance and flavor constituents. Similar results were reported by Hasanuzzaman (2014) in tomato candy and Deepak Singh Rathore (2020) in Ber candy.

Taste (sensory score) of Mango candy was observed to decrease continuously up to the end of research under ambient storage conditions. At beginning of storage best Taste (sensory score) 8.55 was observed in T2 [Mint syrup (1.0%)] followed by 8.52 observed in T8 [Mint syrup (0.5%) +Tulsi syrup (0.5%) + Lemongrass syrup (0.5%)] and lowest 8.16 in T3 [Tulsi syrup (0.5%)]. At 60 days after storage best taste (sensory score) recorded is 8.14 in T2 [Mint syrup (1.0%)] followed by 8.13 observed in T8 [Mint syrup (0.5%) +Tulsi syrup (0.5%) + Lemongrass syrup (0.5%)] and lowest is 7.64 in T3 [Tulsi syrup (0.5%)]. Taste in any food commodity plays important role in deciding its market value. This might be due to degradation of volatile substance and flavor constituents. Similar results were reported by Ames [3] and Chavan [4] in Jackfruit products.

Texture (sensory score) of Mango candy was observed to decrease continuously up to the end of research under ambient storage conditions. At beginning of storage best Texture (sensory score) 8.97 was observed in T2 [Mint syrup (1.0%)] followed by 8.86 observed in T1 [Mint syrup (0.5%)] and lowest 8.29 in T3 [Tulsi syrup (0.5%)]. At 60 days after storage best texture (sensory score) recorded is 8.91 in T2 [Mint syrup (1.0%)] followed by 8.90 observed in T8 [Mint syrup (0.5%) +Tulsi syrup (0.5%) + Lemongrass syrup (0.5%)] and lowest is 8.09 in T3 [Tulsi syrup (0.5%)]. Texture in any food commodity plays important role in deciding its market value. This might be due to degradation of volatile substance and flavour constituents. Similar results were reported by Ames [3] and Chavan [4] in Jackfruit products [5-10].

Overall acceptability (sensory score) of Mango candy was observed to increase continuously up to the end of research under ambient storage conditions. At beginning of storage best Overall acceptability (sensory score) 8.44 was observed in T2 [Mint syrup (1.0%)] followed by 8.37 observed in T8 [Mint syrup (0.5%) +Tulsi syrup (0.5%) + Lemongrass syrup (0.5%)] and lowest 7.85 in T3 [Tulsi syrup (0.5%)]. At 60 days after storage best overall acceptability (sensory score) recorded is 8.36 T2 [Mint syrup (1.0%)] followed by 8.25 observed in T1 [Mint syrup (0.5%)] and lowest is 7.63 in T3 [Tulsi syrup (0.5%)]. Overall acceptability in any food commodity plays important role in deciding its market value. The increase in overall acceptability score may be due to absorption of atmospheric moisture, dilution of sugars and changes in acidity, oxidation of ascorbic acid as well as changes in biochemical constituents of candy. Similar results were reported by Sharma (2013) in apple candy [11-14].

It is the evident from the treatment details that highest benefit cost ratio was recorded in T2 Mint syrup (1.0%) (1.83) and followed by T0 [Control] (1.81) and lowest benefit cost ratio was recorded in T4 (Tulsi syrup (1.0%)) (1.39) [15-17].

Table 1. Effect of herbal flavour on TSS (^{0}B), acidity% and ascorbic acid (mg/100g) of mango candy during storage

Treatment	Total Soluble Solid (^{0}B)					Acidity (%)					Ascorbic acid (mg/100g)				
	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS
T_0	73.24	73.39	73.54	75.20	76.02	0.95	0.93	0.92	0.91	0.88	31.10	30.14	29.18	27.42	26.09
T_1	74.36	74.54	74.71	75.38	76.28	0.98	0.97	0.97	0.94	0.93	31.98	31.01	30.04	28.28	26.14
T_2	77.93	78.22	78.50	80.18	80.86	1.00	0.98	0.97	0.95	0.94	32.07	31.11	30.15	28.39	27.19
T_3	74.14	74.41	74.68	76.00	76.90	0.96	0.95	0.95	0.94	0.92	31.85	30.89	29.93	28.10	26.03
T_4	75.47	75.76	76.04	77.40	78.32	0.93	0.92	0.91	0.87	0.82	31.99	31.01	30.03	28.19	26.92
T_5	76.97	77.13	77.29	78.92	79.80	0.92	0.90	0.89	0.85	0.80	29.94	29.42	28.90	27.11	25.60
T_6	75.35	75.57	75.79	77.18	78.03	0.95	0.94	0.93	0.91	0.88	31.49	30.60	29.71	27.91	26.33
T_7	73.23	73.39	73.55	75.21	76.34	0.99	0.97	0.96	0.93	0.92	31.84	30.89	29.94	28.06	26.04
T_8	74.34	74.52	74.70	75.37	76.28	0.97	0.96	0.95	0.91	0.92	31.95	30.99	30.04	28.16	26.52
F Test	S	S	S	S	S	NS	NS	NS	S	S	S	S	S	S	S
SE (m)	0.54	0.54	0.55	0.60	0.58	0.01	0.01	0.01	0.01	0.02	0.23	0.19	0.15	0.14	0.16
CD at 5%	0.24	0.24	0.25	0.27	0.26	0	0	0	0.01	0.01	0.10	0.08	0.07	0.06	0.07

Table 2. Effect of herbal flavour on Reducing sugar %, non-reducing sugar %, and Total sugar % of mango candy during storage

Treatment	Reducing sugar (%)					Non-reducing sugar (%)					Total sugar (%)				
	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS
T_0	23.7	23.99	24.27	24.9	25.45	30.51	32.05	32.78	32.94	33.59	54.21	55.63	57.05	57.84	59.04
T_1	23.97	24.26	24.54	25.1	25.76	32.09	33.17	32.8	33.6	34.24	56.06	56.7	57.34	58.7	60
T_2	24.49	24.78	25.06	25.7	26.28	33.34	34.47	34.05	34.77	35.59	57.83	58.47	59.11	60.47	61.87
T_3	23.58	23.82	24.05	24.5	25.02	33.08	34.38	33.89	34.8	35.58	56.66	57.3	57.94	59.3	60.7
T_4	24.45	24.74	25.02	25.7	26.01	33.28	34.27	34	34.89	35.26	57.73	58.38	59.02	60.59	61.27
T_5	23.91	24.2	24.49	25	25.18	32.62	33.42	33.35	34	34.22	56.53	57.19	57.84	59	59.4
T_6	24.01	24.29	24.57	25.15	25.61	32.49	33.63	33.48	34.17	34.77	56.5	57.28	58.05	59.32	60.38
T_7	24.41	24.71	25.01	25.74	26.05	31.62	32.8	32.3	33.02	33.97	56.03	56.67	57.31	58.76	60.02
T_8	23.93	24.2	24.46	25.03	25.21	33.27	35.31	34.67	33.46	34.74	57.8	58.47	59.13	60.49	61.85
F Test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
SE (m)	0.11	0.11	0.12	0.14	0.12	0.34	0.17	0.25	0.29	0.27	0.38	0.32	0.27	0.32	0.28
CD at 5%	0.05	0.05	0.05	0.06	0.05	0.15	0.08	0.11	0.13	0.14	0.17	0.14	0.12	0.14	0.14

Table 3. Effect of herbal flavour on score of color, flavor and taste of mango candy during storage

Treatment	Colour					Flavour					Taste				
	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS
T_0	8.81	8.77	8.72	8.66	8.62	8.46	8.41	8.36	8.24	7.64	8.4	8.34	8.27	8.11	7.9
T_1	8.93	8.9	8.87	8.83	8.79	8.5	8.45	8.39	8.27	7.72	8.45	8.4	8.34	8.03	8.03
T_2	8.98	9	8.98	8.94	8.92	8.54	8.49	8.43	8.31	7.86	8.55	8.51	8.46	8.34	8.14
T_3	8.43	8.37	8.3	8.21	8.1	8.33	8.29	8.24	8.14	7.55	8.16	8.13	8.09	7.93	7.64
T_4	8.68	8.63	8.57	8.5	8.44	8.44	8.39	8.34	8.22	7.48	8.4	8.33	8.25	8.08	7.85
T_5	8.53	8.47	8.4	8.31	8.24	8.42	8.36	8.3	8.18	7.31	8.28	8.21	8.14	8.01	7.77
T_6	8.73	8.69	8.64	8.57	8.51	8.45	8.4	8.34	8.22	7.59	8.37	8.31	8.25	8.08	7.88
T_7	8.83	8.79	8.74	8.69	8.65	8.42	8.37	8.32	8.22	7.62	8.36	8.3	8.24	8.12	7.86
T_8	8.65	8.54	8.45	8.45	8.64	8.49	8.47	8.45	8.32	7.75	8.52	8.48	8.43	8.32	8.13
F Test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
SE (m)	0.07	0.07	0.07	0.08	0.07	0.02	0.02	0.02	0.02	0.02	0.04	0.04	0.04	0.05	0.04
CD at 5%	0.03	0.03	0.03	0.04	0.04	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02

Table 4. Effect of herbal flavour on score of texture and overall acceptability and benefit cost ratio of mango candy during storage

Treatment	Texture					Overall acceptability					
	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS	0 DAS	15 DAS	30 DAS	45 DAS	60 DAS	B:C Ratio
T_0	8.71	8.49	8.26	8.1	8.61	8.23	8.16	8.09	8.05	8.03	1.81
T_1	8.86	8.6	8.33	8.02	8.78	8.35	8.32	8.31	8.29	8.25	1.61
T_2	8.97	8.71	8.45	8.33	8.91	8.44	8.41	8.39	8.37	8.36	1.83
T_3	8.29	8.19	8.08	7.92	8.09	7.85	7.76	7.67	7.65	7.63	1.58
T_4	8.56	8.4	8.24	8.07	8.43	8.1	8.02	7.94	7.92	7.91	1.39
T_5	8.39	8.26	8.13	8	8.23	7.95	7.86	7.77	7.73	7.7	1.57
T_6	8.63	8.44	8.24	8.07	8.5	8.15	8.13	7.98	7.95	7.91	1.53
T_7	8.73	8.48	8.23	8.11	8.64	8.25	8.18	8.11	8.08	8.01	1.44
T_8	8.84	8.63	8.42	8.31	8.9	8.37	8.33	8.22	8.21	8.19	1.51
F Test	S	S	S	S	S	S	S	S	S	S	
SE (m)	0.07	0.06	0.04	0.05	0.06	0.06	0.06	0.03	0.04	0.05	
CD at 5%	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.01	0.02	0.02	

4. CONCLUSION

Based on present investigation, it is concluded that T2 [Mint syrup (1.0%)] was best in terms of best recipe with value addition for preparation of mango candy. The same treatment T2[Mint syrup (1.0%)] was found best in terms of quality changes in mango candy during storage. The maximum B:C ratio was observed in T2[Mint syrup (1.0%)].

5. FUTURE SCOPE

Production and marketing of fruits and vegetables must develop into production aspects, marketing aspects, processing and manufacturing aspects. There is tremendous production of fruits and vegetables in a shorter period. Therefore, to avoid the post-harvest loss and to increase substantial returns to processors for off season consumption. Availability of cheap labour, Government Subsidy for cold storage and processing units, convenience of roads in case for marketing and transport. Availability of cans, bottles, and other equipment at cheap rate, there is tremendous for export of processed products like Jam, jelly, marmalade, pickles, etc. dehydrated and dried vegetables in addition to domestic demand in India.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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