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Studies on Economics and Microbial Contamination of Mango Pulp Stored under Different Temperature

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Abstract
A research was carried out during 2011-12 in Department of Horticulture, College of Agriculture, J.A.U., Junagadh. Physico-chemical analysis was carried out for 30 days interval up to 240 days of storage period. The experiment comprised of four levels of mango varieties *viz.*, 'Kesar' (V_1), 'Alphanso' (V_2), 'Dasheri' (V_3) and 'Desi' (V_4), three levels of storage temperatures *viz.*, 12 °C temperature (T_1), 14 °C temperature (T_2) and ambient temperature (T_3). During storage of pulp the 'Kesar' pulp stored at 12 ^{0}C temperature is most beneficial as compared to other treatments. In concern of microbial load of the product; showed increase trend with advancement of storage period. Minimum fungal and bacterial colony was found in 'Alphanso' pulp stored at 12 ^{0}C temperature throughout the progressive period.

Keywords: Mango Pulp, Storage Temperature, Economics, Fungal and Bacterial Load

1. Introduction
Mango (*Mangifera indica* L.) is one of the most popular and most important tropical fruit. It belongs to the family *Anacardiaceae* and considered to be "The king of fruits" in India. In India, mango cultivated area decreased from 2.312 to 2.297 million ha, but production increased from 15.027 to 15.188 million MT as productivity increased from 6.5 to 6.6 MT/ha from year 2009-10 to 2010-11 (Anon., 2011) [2]. Mango contains a high concentration of sugars (16-18 % w/v) and acids with organoleptic properties and also contains antioxidants like carotene (as Vitamin A- 4800IU). As per USDA database, 100 g of mango give 272 kJ energy, 0.51 g protein, 0.27 g fat, 17 g carbohydrate, 1.8 g fiber, 14.8 g total sugars, 10 mg calcium, 11 mg phosphorous, 156 mg potassium, 9 mg magnesium and 2 mg sodium (Anon., 2008) [1]. Mango is short seasoned fruit and being highly perishable does not withstand even in cold storage. The abundant supply of mango in the market from the majority of orchard takes place in a short span which causes glut in the market thereby, causing reduction in prices. Therefore, value addition in mango fruits becomes necessary in order to minimize the glut in the market during its peak season of production. Mango is processed into several products in domestic as well as at commercial level in India and abroad. In India, pulps have a good demand throughout the year; therefore, most of the fruit industry in India preserves mango pulp for the manufacture of mango product around the year. This present study was conducted to evaluate the mango varieties for processed pulp under different storage conditions.

Materials and Methods
Matured, unripe and uniform sized of mango were purchased from college farm and Junagadh local market and brought to the Department of Horticulture laboratory for experimentation. The diseased, damaged and off type fruits were discarded. The selected fruit were thoroughly washed with tap water to remove dirt and dust particles adhering to the surface of fruit and were allowed to surface dry. Then they were packed in cardboard boxes for uniform ripening at ambient conditions for 6 to 7 days, peeling, coring, and cutting was carried out using stainless steel knife. The mango pulp was extracted through pulper machine.

Experimental design: The experiment was laid out in a Completely Randomized Design (with Factorial concept) with 4 replications.

Experimental details: The experiment comprised of 12 treatment combinations consisting 4 mango varieties and 3 temperatures of storage. The details of various treatments are presented below:

Sr. No.	Treatments	Notation
1	*Kesar* + 12^{0}C	V_1T_1
2	*Kesar* + 14^{0}C	V_1T_2
3	*Kesar* + Ambient Temperature	V_1T_3
4	*Alphanso* + 12^{0}C	V_2T_1
5	*Alphanso* + 14^{0}C	V_2T_2
6	*Alphanso* + Ambient Temperature	V_2T_3
7	*Dasheri* + 12^{0}C	V_3T_1
8	*Dasheri*+ 14^{0}C	V_3T_2
9	*Dasheri* + Ambient Temperature	V_3T_3
10	*Desi* + 12^{0}C	V_4T_1
11	*Desi* + 14^{0}C	V_4T_2
12	*Desi* + Ambient Temperature	V_4T_3

Methodology for mango pulp processing:
Mango pulp was processed under the methodology given by the Nanjundaswamy (1997) [8] (Fig. 1). The final product was periodically evaluated in storage on 0, 30th, 60th, 90th, 120th, 150th, 180th, 210th and 240th day for understanding the live compositional status of fresh product as well as processed pulp.

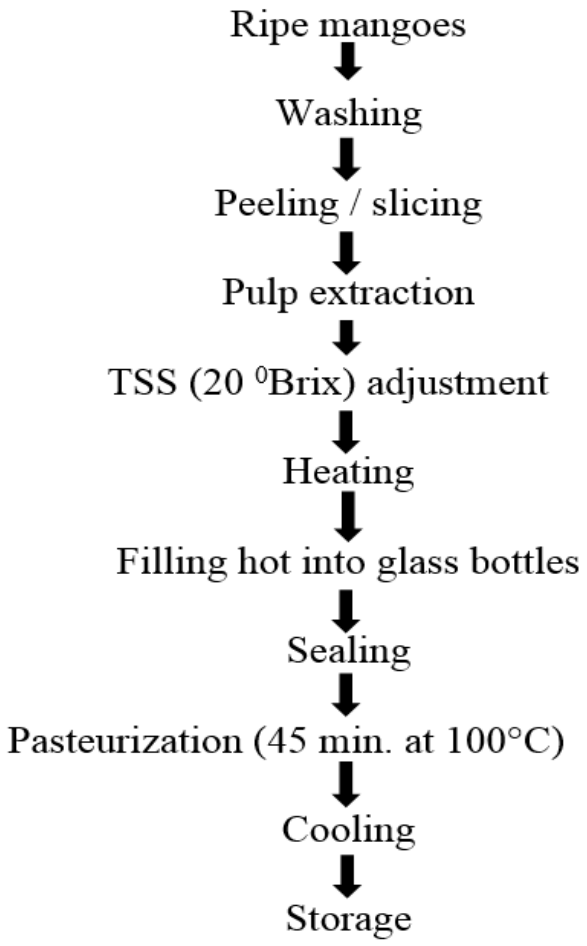

Fig 1: Flow Chart showing the procedure to prepare mango pulp

Economics of the treatments: The economics of different treatment was calculated on the basis of cost of the treatment.

Microbial Load: The determination of total fungal and bacterial contamination of the stored pulp sample was performed after 30 days interval until 240 days by serial dilution and spread plate method.

Result and Discussion

Economics of the treatments

It is evident from the data that maximum net benefit of ` 1216.67 was obtained in the 'Kesar' pulp stored at 120C temperature, whereas minimum net benefit of ` 595.00 was obtained in the 'Desi' pulp stored at ambient temperature (Table 1). As far as net benefit cost ratio is concerned, the highest (1:3.1) net B:C ratio of treatment was recorded in the 'Kesar' pulp stored at 120C temperature followed by the 'Alphanso' pulp stored at 120C and ambient temperature, whereas minimum (1:2.1) was observed in 'Desi' pulp stored at ambient temperature.

Table 1: Relative economics of the treatments

Treatment	Treatment cost (`)	Price of the product (`)	Net benefit	Net B:C ratio
	2	3	4 (3-2)	5 (2:4)
V_1T_1	583.33	1800.00	1216.67	1:3.1
V_1T_2	575.00	1620.00	1045.00	1:2.8
V_1T_3	516.67	1280.00	0763.33	1:2.5
V_2T_1	600.00	1800.00	1200.00	1:3.0
V_2T_2	591.67	1620.00	1028.33	1:2.7
V_2T_3	433.55	1280.00	0846.45	1:3.0
V_3T_1	608.34	1440.00	0831.66	1:2.4
V_3T_2	600.00	1440.00	0840.00	1:2.4
V_3T_3	516.67	1120.00	0603.33	1:2.2
V_4T_1	591.67	1600.00	1008.33	1:2.7
V_4T_2	583.33	1440.00	0856.67	1:2.5
V_4T_3	525.00	1120.00	0595.00	1:2.1

*Number of bottles: 40 bottles per each treatment combination.

Microbial Load

The data recorded in present investigation indicates that fungal and bacterial load on mango pulp were increased from 0 day up to 240 days (Table 2 and 3). However, the rate of increased in fungal and bacterial colony load affected by various variety and storage temperature. The growth was found to be highest in 'Dasheri' pulp stored at ambient temperature, while lowest in 'Alphanso' pulp stored at 12^{0}C, which may be attributed to the chemical changes, specifically alteration in the pH of the system that would take place resulting from the presence of the chemical preservatives in the samples. The osmophilic yeasts recorded highest counts after 240 days of storage. Mango pulp prepared at high temperature (above 65^{0}C) stored under frozen conditions in cans and aseptic packages with and without addition of preservatives recorded very low surviving population of microorganisms. Similar finding was reported by Garg *et al.* (1995) [4], Hussain *et al.* (2003) [5], Akthar *et al.* (2010), Ravi *et al.* (2011) [9] and Younis *et al.* (2011) [11] in mango pulp, Isaacs (1991) in mango puree, Singh *et al.* (2005) [10] in mango bar, Chakraborty *et al.* (2011) in passion-mango blended squash and Kalsi (2002) [6] in guava pulp and RTS.

Table 2: Interaction effect of different varieties (V) and temperatures (T) on fungal counts (CFU/g) of mango pulp during storage

Treatment	Storage periods (days)								
	0	30	60	90	120	150	180	210	240
V_1T_1	Nil	Nil	Nil	Nil	4	6	12	26	33
V_1T_2	Nil	Nil	Nil	1	2	9	15	37	59
V_1T_3	Nil	Nil	Nil	Nil	2	12	26	69	82
V_2T_1	Nil	Nil	Nil	Nil	3	5	11	25	31
V_2T_2	Nil	Nil	Nil	1	3	8	16	40	58
V_2T_3	Nil	Nil	1	3	4	13	30	68	77
V_3T_1	Nil	Nil	Nil	2	5	10	14	44	63
V_3T_2	Nil	Nil	Nil	4	5	14	25	46	71
V_3T_3	Nil	2	2	3	7	18	39	73	89
V_4T_1	Nil	Nil	Nil	2	3	9	14	34	45
V_4T_2	Nil	Nil	Nil	1	2	9	14	37	65
V_4T_3	Nil	1	1	2	3	14	36	68	84

Table 3: Interaction effect of different varieties (V) and temperatures (T) on bacterial counts (CFU/g) of mango pulp during storage

Treatment	Storage periods (days)								
	0	30	60	90	120	150	180	210	240
V_1T_1	Nil	Nil	Nil	2	3	10	22	30	86
V_1T_2	Nil	1	3	5	7	18	37	48	107
V_1T_3	Nil	2	5	7	9	15	33	114	175
V_2T_1	Nil	Nil	Nil	1	2	12	22	28	73
V_2T_2	Nil	1	2	3	4	9	21	32	102
V_2T_3	Nil	2	4	5	6	15	33	109	169
V_3T_1	Nil	Nil	1	3	4	11	26	54	117
V_3T_2	Nil	1	2	4	6	18	39	76	151
V_3T_3	Nil	2	5	6	8	24	46	122	191
V_4T_1	Nil	Nil	1	2	3	6	13	31	85
V_4T_2	Nil	Nil	1	3	5	18	38	48	93
V_4T_3	Nil	2	5	5	6	12	32	112	173

Conclusion

We know that the mango fruits are available in bulk during on season and this become a useful raw material for processing industries. If suitable technology is provided, some viable products manufacture is possible. Accordingly studies were conducted to prepare mango pulp for evaluation of mango varieties for processed pulp under different storage conditions, the storage life of processed pulp made from different mango varieties, evaluation of qualitative performance of processed pulp prepared from different mango varieties during storage and economic feasibility of treatments.

Among the various treatments attempt in the present study, the 'Kesar' pulp stored at 12 ^{0}C temperature was found to be most economic with highest B: C ratio. As far as microbial contamination is concerned, 'Alphanso' pulp stored at 12 ^{0}C temperature resulted in the lowest fungal and bacterial load. Therefore, the 'Kesar' and 'Alphanso' varieties, and 12 ^{0}C storage temperature is recommended for the preparation and storage of highest profitable and less microbial contaminated mango pulp.

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