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STANDARDIZATION OF A PROCESS FOR THE PRODUCTION OF MANGO-FLAVOURED MILK

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Abstract. A standardized process was developed for the production of mango-flavoured milk in Pakistan. Powdered skim milk, fresh mango pulp and canesugar were used as basic ingredients. 16 out of 50 combinations of pectin, gelatin and guar-gum were tested as stabilizers. The effect of room (80–95°F) and refrigerator (40–45°F) storage on their important physicochemical and organoleptic characteristics was studied. Maximum shelf-life was 348 hr at 40–45°F in contrast to 25½ hr at 80–95°F. Gelatin proved best as a stabilizer while the pectin blends were better organoleptically. Lastly, 4 recipes for the preparation of mango-milk blends are given.

Milk is an ideal food and an excellent beverage. In Pakistan where its consumption is 50% less than the recommended international levels, only 23% of the total milk supply is consumed as fluid milk. At the same time Pakistan ranks second in the mango-growing world. The quick perishability of mangoes as well as milk causes heavy losses to the national health and economy.

The present paper, therefore, is an attempt to develop standardized process for the production of a stable mango-milk blend in order to increase the consumption of delicious milk foods fortified by nice fruit flavours, vitamins and valued minerals. Realizing the importance of fruit-flavoured milk, attempts were made to develop technical formulae for the luscious mango-milk blends with better keeping quality without affecting their overall wholesomeness and nutritional value.

Charley[3] utilized various fruit syrups and cordials to produce stable fruit-flavoured milk using sulphur dioxide and sodium benzoate as preservatives. He found that strawberry and raspberry flavours decreased the pH of the blends most rapidly when added to milk. Sattar and Bhatti[14] standardized the manufacture of strawberry-milk shakes in Pakistan. Shih[15] in Nationalist China, produced flavoured-milks using pineapple, essence, sugar and pineapple juice in varying proportions.

Hughes[8] combined orange juice with milk without curdling using gelatin at a special temperature. Bhatti *et al.*[2] worked out a formula for stable orange-beverage base and orange-flavoured milk shake by combining orange-beverage base and fluid milk using citrus-pectin solution as a stabilizer. They found that vitamin C loss in the skim milk blends was greater than in whole-milk blends.

Monzini and Bognetti[11] prepared mixtures of milk and fruit pulps having a pH less than 4.6 using viscous solutions of pectin and carboxy-methyl cellulose as stabilizer. Smith[16] described a patent on stabilized liquid vanilla milk shake mixes using glycol monostearate.

Rembowski *et al.*[12] have tested various stabilizers in the manufacture of milk-fruit mixes. They found that pectin with a high degree of esterification of methoxy groupings proved best as a stabilizer. Hendrick *el al.*[6] studied the possibility of manufacturing cherry-flavoured milk drinks and other dairy products using pectin, carboxymethyl-cellulose and and various buffering salts such as dipotassium hydrogen phosphate. Gorecka *et al.*[5] reported that high temperature of storage leads to the curding of milk case in and to unfavourable colour changes in milk-fruit beverages.

Materials and Methods

Fresh suckling mangoe's pulp obtained manually, defatted milk powder, and cane sugar were utilized as basic ingredients. Milk powder was reconstituted on the basis of 10% solids-not-fat. It was pasteurized at 185–195°F for ½ hr. Strained mango pulp was separately heat-treated at 140–150°F for ½ hr before mixing it with milk.

After cooling, calculated volumes of mango-milk blends were made by adding 5, 10, 15, 20 and 25% of the pulp by volume. Aqueous solutions (2%) of the three stabilizers viz, pectin, gelatin and guar gum were also added to the blends at the rate of 0, 10, 20, and 30% by volume. Finally, the calculated amounts of the cane sugar were added to each blend to fix its initial °Brix at 16.

Out of 50, only 16 blends were selected after a preliminary organoleptic examination and after observing their one day's stability in the refrigerator (Table 1). These blends were then bottled, processed at 143.5–145.5°F for 30 min and finally stored at room (80–95°F) and refrigerator (40–45°F) temperatures (Table 2). The following physicochemical and organoleptic characteristics were evaluated after every 12 hr interval at room storage and after every 24-hr interval at refrigerator storage. The observations were regularly recorded in 2 replications until spoilage occurred.

TABLE 1

Treatment codes	Milk-pulp-stabilizer ratios	Scores obtained out of 50 — Judges A	B	C	D	E	F	Average scores
3 *Pectin-stabilized blends*								
A–1	85: 5:10	27	23	31	32	41	25	29·8
D–1	80:10:10	27	27	38	32	38	34	32·7
G–1	75:15:10	32	21	40	30	34	30	31·2
8-*Gelatin-stabilized blends*								
B–1	85: 5:10	33	10	34	27	21	26	25·2
B–2	75: 5:20	32	10	28	26	20	27	23·8
B–3	60:10:30	25	15	36	29	29	30	27·3
H–1	75:15-10	27	10	36	27	26	27	25·5
H–2	65:15:20	24	10	22	31	26	28	23·5
K–1	70:20:10	28	15	38	33	31	30	29·2
K–2	60:20:20	28	15	35	35	29	30	28·7
K–3	50:20:30	25	10	32	37	32	31	27·8
5-*Nonstabilized blends*								
S–1	95: 5: 0	33	10	25	23	20	22	23·2
S–2	90:10: 0	28	10	25	25	29	26	23·8
S–3	85:15: 0	25	10	25	27	28	24	23·2
S–4	80:20: 0	30	12	27	33	31	32	27·5
S–5	75:25: 0	33	11	26	30	35	28	27·2

TABLE 2. ANALYSIS OF VARIANCE.

Source of variation	D.F.	S.O.	M.S.	F.R.
Judges	5	3379·344	675·869	334·589*
Treatments	15	847·573	56·505	27·973*
Error	75	151·490	2·020	
Total	95	4378·407	46·088	

*Highly significant.

$Cd_1 = (2{\cdot}020 \times 2/6)\,\frac{1}{2} \times 1.99 = 1{\cdot}6328$
$Cd_2 = (2{\cdot}020 \times 2/6)\,\frac{1}{2} \times 2.65 = 2{\cdot}1743$

1. °Brix were read from the Abbe's refractometer.[7]
2. Visual colours were compared with standard colours in a colour dictionary by Maerz and Paul.[10]
3. Total solids (% w/w) were determined by a gravimetric method described by A.P.H.A.[1]
4. pH was read from the pH meter.[13]
5. Acidity (% w/w) as lactic acid was determined by a method given by Horwitz.[7]
6. Vitamin C was assessed by 2, 6-dichlorophenol–indophenol visual titration method as reported by Freed.[4]
7. Organoleptic examination was conducted under the instructions given by Krum.[9]

The panel's scores and the shelf lives of the blends as affected by the 2 temperatures' level were separately examined for significant differences by the analysis of variance technique.

Results and Discussions

The highly significant differences among the combinations' scores at 1% level of significance during the course of preliminary organoleptic examination are given in Table 1. It was striking to note that all those combinations which contained guar gum stabilizer were thoroughly eliminated and could not find a place within the 16 selected blends. While studying the effect of stabilizers on the shelf life of the blends, it was found that all the blends had insignificant differences in their shelf lives at room temperature at 5% level of significance. But at the refrigerator storage, stability of all blends increased in general. The pectin-stabilized blends were the least stable surviving for 48–96 hr nonstabilized blends were in between with an average shelf lives of 72–216 hr while the gelatin-stabilized blends were the best in their stability and their shelf lives ranged from 48 to 348 hr. Stabilizers had little resisting effect on pH and acidity of the blends. Pectin-stabilized blends superseded all blends in their organoleptic quality.

TABLE 3. AVERAGE GRADES IN DESCENDING ORDER.

D–1	G–1	A–1	K–1	K–2	K–3	S–4	E–3	S–5	H–1	B–1	B–2	S–2	H–2
32.7	31.2	29.9	29.2	28.7	27.8	27.5	27.3	27.2	25.5	25.2	23.8	23.8	23.5

S–3	S–1
23.2	22.2

TABLE 4. EFFECT OF TIME AND TEMPERATURE ON THE CHARACTERISTICS OF THE MANGO–FLAVOURED MILK BLENDS AT THE BEGINNING AND END OF THE ROOM TEMPERATURE STORAGE (80-95°F)

Characteristics of the mango–milk blends	Storage	
	Beginning	End
5–Nonstabilized Mango-Milk Blends(Avg. Shelf Life=13.0–18.5 *hr)*		
°Brix	16·000	16·000
pH	5·600– 6·250	4·900– 5·800
Acidity as lactic acid(%w/v)	0·179– 0·249	0·227– 0·315
Total solids (%w/w)	16·013–16·099	15·977–16·083
Vit C (mg/100 ml)	0·213– 1·029	0·138– 0·550
3–Pectin-Stabilized Mango-Milk Blends (Avg. Shelf Life=13.0–15·0 *hr)*		
°Brix	16·00	16·00
pH	5·875– 6·075	5·75 – 5·750
Acidity as lactic acid(%w/v)	0·198– 0·222	0·235– 0·260
Total solids (%w/w)	16·057–16·164	16·005–16·108
Vit C (mg/100 ml)	0·179– 0·653	0·133– 0·543
8–Gelatin-Stabilized Mango-Milk Blends (Avg. Shelf-Life=13·5R25·5 *hr)*		
°Brix	16·000	16·000
pH	5·925– 6·550	5·500– 6·375
Acidity as lactic acid(%w/v)	0·122– 0·215	0·160– 0·270
Total solids (%w/w)	15·948–16·007	16·002–16·300
Vit C(mg/100 ml)	0·173– 0·874	0·105– 0·435

TABLE 5. EFFECT OF TIME AND TEMPERATURE ON THE CHARACTERISTICS OF THE MANGO-FLAVOURED MILK BLENDS AT THE BEGINNING AND END OF THE REFRIGERATOR TEMPERATURE STORAGE (40-45°F).

Characteristics of the mango-milk blends	Storage	
	Beginning	End
5–Non-Stabilized Mango-Milk Blends (Avg. Shelf-life=72–216 *hr)*		
°Brix	16·000	16·500–18·750
pH	6·075– 6·975	4·950– 5·875
Acidity as lactic acid(%w/v)	0·136– 0·192	0·214– 0·315
Total solids (%w/w)	15·992–16·057	15·980–16·134
Vit C(mg/100 ml)	0·099– 0·445	0·082– 0·235
3–Pectin-stabilized Mango-Milk Blends (Avg. Shelf-life= 48–96 *hr)*		
°Brix	16·000	16·375–16·975
pH	6·250– 6·350	5·600– 5·900
Acidity as lactic acid(%w/v)	0·162– 0·178	0·212– 0·259
Total solids (%w/w)	16·007–16·000	15·995–16·026
Vit C(mg/100 ml)	0·104– 0·302	0·085– 0·246
8–Gelatin-Stabilized Mango-Milk Blends (Avg. Shelf-life= 48–348 *hr)*		
°Brix	16·000	16·500–19·750
pH	6·475– 6·750	5·250– 6·125
Acidity as lactic acid(%w/v)	0·083– 0·155	0·189– 0·304
Tota solids (%w/w)	15·968–16·041	15·989–16·192
Vit C(mg/100 ml)	0·099– 0·363	0·047– 0·230

The effect of temperature on the storage life of the blends was quite apparent. At room temperature (80–95°F) only 2 blends, K-3 and H-2 had a shelf life of 25.5 and 25.0 hr respectively while the shelf life of remaining blends varied from 13.0 to 21.5 hr. But at the refrigerator temperature (40–45°F), 6 blends viz, S-5, S-4, K-1, K-3, K-2 and H-2 survived for 132, 216, 228, 240, 336 and 348 hr respectively while the stability of the rest varied between 48–96 hr (Table 3).

Tables 4 and 5 respectively show the effect of time and temperature on the characteristics of the mango-flavoured milk blends at the beginning and the end of room (80–95°F) and refrigerator (40–45°F) temperatures storage.

The cumulative effect of temperature and storage on the physicochemical characteristics and organoleptic quality of the blends was also observed and recorded as under: (a) °Brix of all blends increased with storage life. (b) Per cent total solids were almost constant. However in some cases the values of the total solids fell below the minimum °Brix which apparently may be due to some experimental error. (c) Browning in the shades of the visual colours of the blends was observed on storage. (d) pH decreased more rapidly at room storage than at the refrigerator storage in all blends except the gelatin-stabilized blends where the rate of decrease was steady. (e) Acidity of all blends except the gelatin-stabilized increased tremendously at room storage than at the refrigerator storage. (f) Vitamin C decreased in all blends fairly uniformly irrespective of the composition of the blends. (g) Organoleptically, all blends scored between good to fair grades during the first 12 hr at room temperature but afterwards rapidly degraded from poor to very poor grade. At refrigerator storage, during the first 24 hr all blends improved their organoleptic scores but afterwards began to deteriorate in quality gradually up to the 144 hr interval, after which the fluctuations in quality remained constant within the 'fair' grade till spoilage.

Four Formulations are being recommended as recipe, i.e. H-2, K-2, D-1 and G-1. H-2 and K-2 blends can be stored successfully for a period of a fortnight or more when stored at 35–40°F. D-1 and G-1 excell all the remaining blends in their overall better organoleptic quality but they lack in good storage life.

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