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Evaluation of Isabgul (Psyllium) Husk and Gum Acacia as Ice-cream Stabilizers

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ABSTRACT

Isabgul (Psyllium) husk and gum acacia were compared as ice cream stabilizers with sodium alginate. The criteria studied included effects on viscosity, whipping ability, freezing temperature, melting resistance and organoleptic characteristics of finished product (before and after heat shock).

Isabgul husk gave almost comparable results with sodium alginate with regard to all the properties studied, except viscosity values which were lower than sodium alginate at 0·3 and 0·4% additions. Sodium alginate and isabgul husk yielded organoleptically satisfactory product at 0·3 and 0·4% levels. Gum acacia mixes developed very low viscosities and gave higher melting resistance when compared with sodium alginate. Organoleptically, it gave satisfactory product only at 0·4% addition.

The study reveals that isabgul husk has required characteristics to act as an ice cream stabilizer and can be developed as suitable economical substitute for sodium algintae.

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INTRODUCTION

RECENTLY algin derivatives and carboxymethyl cellulose have gained popularity as ice cream stabilizers. However, in India, this is not so, probably on account of their high prices and lack of availability. Thus a need was felt to search for cheap and suitable indigenous substitutes for sodium alginate and/or carboxymethyl cellulose.

The seeds of isabgul (*Plantago ovata*), a crop widely cultivated in the northern Gujarat and elsewhere in India, have mucillages comparable to methyl cellulose and sodium alginate. In view of this, in the present study, husk derived from isabgul seeds and gum acacia, another potential indigenous substitute, were selected and compared with sodium alginate to establish their effectiveness or otherwise as ice cream stabilizers.

Sodium alginate as an ice cream stabilizer has been extensively studied by Anderson, *et al* (1937), Mack (1936), Stebnitz and Sommer (1937) and Tracy and Tuckey (1939). Influence of gum acacia on whipping ability and flavour of ice cream has been studied by Jain and Rawat (1972a, 1972b) and the results have shown possibility of its use.

The selected stabilizers were studied for their influence on viscosity, whipping ability, freezing temperature, melting resistance and organoleptic characteristics of ice cream when fresh and after heat shock.

MATERIALS AND METHODS

A standard mix formula with 12%

fat, 11% milk-solids-not fat (MSNF), 15% sugar and 0·1% emulsifier was used throughout this study. Milk fat was obtained from fresh sweet cream, whereas MSNF were supplied by plain condensed skim milk. The source of both was Jersey cow milk. Cane sugar and emulsifier (glycerol monostearate) were of commercial grades. The stabilizers studied included (i) sodium alginate (Algogel), a product of Cellulose Products of India Ltd., (ii) isabgul husk (crude form) and (iii) gum acacia (edible grade). The rates of addition were 0·1, 0·2, 0·3 and 0·4% (W/W). Control trials contained no stabilizer. There were three replications for each level.

A 20 kg mix was prepared for each treatment. The required quantities of various ingredients were weighed, mixed and blended thoroughly. Addition of stabilizers and emulsifier was done after mixing them with sufficient weight of sugar and before the temperature of the mixture reached 50°C, except for sodium alginate which was added when temperature reached 70°C. The mixes were pasteurized at 72°C for 30 min; homogenized at about 65°C in a Rannie single stage homogenizer, using a pressure of 140 kg/sq cm; cooled to 5°C and aged in a cold store at 5°C for 24 hours.

After aging for 24 hrs the mixes were frozen in a Guisti horizontal batch freezer provided with an arrangement for air incorporation under pressure. All batches of ice cream were flavoured uniformly with vanilla essence (Narden, Bombay) at the rate of 28 ml/20 kg mix. No colour was used. After freezing the mix to a proper consistency, indicated by the ammeter reading, whipping of the mix was done with air at constant gauge pressure (4·5 kg) and the time taken for 90% overrun and temperature of ice cream were recorded. After packaging, product was immediately transferred into hardening room maintained at – 15°C. Ice cream was hardened for 24 hours. Hardened ice cream was then subjected to melting quality test and organoleptic evaluation—both when fresh and after heat shock.

Viscosity measurements were made immediately after cooling and after aging for 4, 8, 12 and 24 hours, using Brookfield Viscosimeter as described by Loe-Wenstein and Haddad (1972a).

Whipping ability of the mix was expressed as the time taken to attain 90% overrun at 4·5 kg air pressure.

Melting quality tests were conducted in duplicate using 100 g of ice cream placed on a wire-mesh screen (256 pores/sq in) as per the method of Loe-Wenstein and Haddad (1972b).

Heat shock treatments to the ice cream were given exposing it to room temperature in a closed container until the interior portion of a litre carton attained – 12°C temperature. They were transferred to hardening room for refreezing at – 15°C. This heat shock treatment was repeated 10 times before organoleptic evaluation.

Organoleptic scoring for flavour and body and texture was done by a panel of five judges when product was fresh and after heat shock.

RESULTS AND DISCUSSION

Effect on mix viscosity: Table 1 shows the basic viscosities of ice cream mixes as affected by the kind of stabilizer, amount of stabilizer and the period of aging. The data revealed that mixes containing sodium alginate (Algogel) had the highest initial and final viscosities for all the levels under study. Mixes with isabgul husk developed almost comparable viscosities to those of sodium alginate when added at the rate of 0·1 and 0·2%. However, at 0·3 and 0·4% concentrations mixes with isabgul husk had lower viscosities than mixes with sodium alginate. This could be attributed to crudeness of the isabgul husk used. Gum acacia mixes had very low viscosities both immediately after processing and after 24 hour aging. Increase in the rate of addition resulted into a very slight rise in the viscosity. Lowest viscosities were observed with control mixes containing no stabilizer.

TABLE 1

Effect of kind of stabilizer, amount of stabilizer and period of aging on the basic viscosity of ice-cream mix.

Amount of Stabilizer (%)	*Average viscosity in centipoise** *Period of aging in hour* 0 (*immediately after processing*)	4	8	12	24
		Sodium alginate (Algogel)			
0·1	38 (84·4)+	40 (88·9)	43 (95·6)	45 (100)	45
0·2	62 (80·5)	72 (93·5)	74 (96·1)	74 (96·1)	77
0·3	164 (83·2)	188 (95·4)	188 (95·4)	193 (98·0)	197
0·4	373 (92·6)	403 (100)	403 (100)	403 (100)	403
		Isabgul Husk			
0·1	38 (84·4)	38 (84·4)	43 (95·6)	43 (95·6)	45
0·2	57 (89·1)	58 (90·6)	60 (93·8)	62 (96·9)	64
0·3	110 (89·8)	117 (95·1)	117 (95·1)	120 (97·6)	123
0·4	269 (94·7)	277 (97·5)	277 (97·5)	284 (100)	284
		Gum Acacia			
0·1	28 (87·5)	30 (93·8)	30 (93·8)	32 (100)	32
0·2	29 (85·3)	31 (91·2)	33 (97·1)	34 (100)	34
0·3	32 (86·5)	33 (89·2)	36 (97·3)	36 (97·3)	37
0·4	39 (83·0)	43 (91·5)	43 (91·5)	43 (91·5)	47
		Control			
No stabilizer	25 (86·2)	29 (100)	29 (100)	29 (100)	29

* Average of three trials. Values have been rounded upto the nearest whole number.

+Figures in parentheses indicate percentage of final viscosity (Viscosity after 24 hrs aging) developed before and during aging. Figures have been rounded.

Figures in the parentheses, representing percentage of final viscosity developed before and during aging, indicated that all the mixes, including those containing no stabilizer developed more than 80% of the final viscosity immediately after processing. Aging of mixes proved of little consequence particularly after 4 hours of aging. This indicates that all the three stabilizers under study have immediate action. Findings of this study, pertaining to sodium alginate, compare well with those of Anderson, *et al* (1937), Mack (1936) and Stebnitz and Sommer (1937) and Tracy and Tuckey (1939) who have reported that sodium alginate mixes develop most of the viscosity immediately after processing.

Effect on whipping ability and freezing temperatures: Data presented in Table 2 show that kind and amount of stabilizers had no appreciable effect on freezing temperature at 90% overrun. Similarly, the time required to reach 90% overrun was nearly the same in all the cases, including the unstabilized control mix, which had the shortest whipping time except mixes containing 0·1 and 0·2% sodium alginate. Increase in the rate of addition of stabilizers resulted in slight increase in the time required to reach 90% overrun. Using different levels, Mack (1936) and Jain and Rawat (1972) have found similar trends with sodium alginate and gum acacia, respectively. Mixes containing sodium alginate revealed a slight advantage in whipping rate as compared to those containing isabgul husk and gum acacia. However, the differences being very slight they could be regarded as of little significance.

Effect on melting quality: Data on melting quality of ice cream, presented in Table 3, revealed that both type and amount of stabilizer influence the resis-

TABLE 2

Effects of various stabilizers on whipping ability and freezing quality of the ice-cream.*

Stabilizer		*Time to attain 90% overrun*		*Temperature at 90% overrun*
Type	*Amount* (%)	*Minute*	*Second*	°*F*
Sodium alginate	0·1	2	57	24
	0·2	2	58	24
	0·3	3	05	23
	0·4	3	10	23
Isabgul husk	0·1	3	02	25
	0·2	3	02	24
	0·3	3	10	24
	0·4	3	12	23
Gum acacia	0·1	3	02	24
	0·2	3	03	24
	0·3	3	08	24
	0·4	3	10	23
Control	No stabilizer	3	00	23

* Average of three trials.

TABLE 3

The influence of various stabilizers on the melting quality of ice-cream.*

Stabilizer *Type*	*Amount*	*Total weight of duplicate sample* (g)	*Quantity of ice cream melted in 40 minutes* *Volume (ml)*	*Weight (g)*	*% of ice cream melted*
Sodium alginate (Algogel)	0·1	200	134·0	148·8	74·4
	0·2	200	149·2	166·0	83·0
	0·3	200	162·6	172·0	86·0
	0·4	200	153·3	162·0	81·0
Isabgul husk	0·1	200	129·3	146·4	73·2
	0·2	200	154·6	171·0	85·5
	0·3	200	151·3	176·0	88·0
	0·4	200	157·3	168·0	84·0
Gum acacia	0·1	200	114·0	123·0	61·5
	0·2	200	112·6	122·0	61·0
	0·3	200	112·6	117·2	58·6
	0·4	200	102·6	107·4	53·7
Control	No stabilizer	200	102·8	111·8	55·9

* Average of three trials. Figures have been rounded.

tance to melting. Sodium alginate and isabgul husk mixes had almost similar behaviour. Increased rate of addition of both upto 0·3% resulted a product with faster melting. At 0·4% level, both showed a slight decline in the rate of melting. The results pertaining to sodium alginate are in conformity with those of Anderson, *et al* (1937), who reported that ice cream with 0·3% sodium alginate melted more freely than those containing lesser amounts. Gum acacia mixes resulted in a product which melted slowly compared to mixes containing sodium alginate and isabgul husk. On the other hand, gum acacia mixes had nearly same melting resistance as that of control mixes. With increase in the rate of addition of gum acacia a decrease in the rate of melting was observed. Further, it will be noted that except gum acacia at 0·4% concentration, none of the stabilizers used improved the melting resistance of the ice cream.

All the three stabilizers gave smooth, creamy melt down with no evidence of curdling.

Effect on organoleptic characteristics: It will be noted from the data presented in Table 4 that neither the kind nor the amount of stabilizers had any appreciable difference in the flavour score of ice cream. Heat shock treatment resulted in a slight decline in the flavour score of ice cream. No adverse criticism was offered by any of the judges at any time.

The kind and the amount of stabilizer used did have a significant effect on the body and texture score of ice cream when fresh and after heat shock. Criticisms ranged from none to very slightly coarse to coarse, icy, crumbly and weak. The ice cream with no stabilizer had the least desirable body and texture when

TABLE 4

The influence of various stabilizers on the organoleptic characteristics of fresh and heat shocked ice cream.*

Stabilizer		*Flavour score out of 45*		*Body and texture score out of 30*	
Type	*Amount (%)*	*Fresh*	*Heat shocked*	*Fresh*	*Heat shocked*
Sodium alginate (Algogel)	0·1	40	39·5	29	27
	0·2	40	40	29·5	28
	0·3	40	40	29·5	28·5
	0·4	40	39·5	29·5	28·5
Isabgul husk	0·1	39·5	39·5	29	26·5
	0·2	40	40	29	27·5
	0·3	39·5	39	29·5	28·5
	0·4	39·5	39	29·5	28·5
Gum acacia	0·1	39·5	39·5	28·5	26
	0·2	39·5	39	28·5	27
	0·3	39·5	39·5	29	28
	0·4	40·0	40	29·5	28·5
Control	No stabilizer	39·5	38·5	28	25

* Average of three trials. Figures have been rounded.

fresh and after heat shock. Ice creams with 0·1 and 0·2% gum acacia were not much better in this regard than those without stabilizer. Addition of 0·3 and 0·4% of gum acacia improved the score and at 0·4% level it was comparable with sodium alginate and isabgul husk. Both sodium alginate and isabgul husk gave comparable performance at various levels, and at 0·3 and 0·4% concentrations both yielded ice creams with satisfactory body and texture.

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