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Studies on development of milk powder based instant kheer-mix

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Abstract
Kheer is a traditional Indian desserts cooked mixture of partially concentrated milk, sugar and rice. Such products have a very limited shelf life and hard to commercially marketed. This study was conducted with an objective to develop instant kheer-mix, because several traditional snack foods offering convenience to fast food industry. Different combination levels of whole milk powder (WMP) and skim milk (SMP) powder (50 to 65%), sugar (25 to 35%) and uniform broken (1mm) basmati rice (10 to 15%) were tried for development of instant kheer-mix. The products were conventionally cooked and selected on the bases of sensory evaluation. The selected products were further evaluated for proximate composition. WMP (57.5%) based reconstituted kheer with sugar (30%) and rice (12.5%), and SMP (52.5%) with sugar (35%) and rice (12.5%) were highly acceptable by the panelists. Kheer-mix based on WMP showed significantly higher fat and protein content with lower carbohydrates than SMP based kheer-mix. It is concluded that SMP (52.5%) based kheer-mix with 35% sugar and 12.5% rice is recommended for consumers preferring low fat diets.

Keywords: Rice, milk powders, instant mix, kheer

Introduction
Kheer is a traditional Indian desserts conventionally prepared food by partial dehydration of whole milk over direct fire together with sugar and usually rice or semolina [1]. Development of ready to cook mix for several traditional snack foods offering convenience to fast food industry and housewives become a fast growing trend among the processed foods. Kheer is highly popular milk based food item among all cross-sections of the population of the Indian subcontinent, irrespective of urban and rural areas [2].

Processes of preparing different dairy culinary arts and skills are often inconvenient and therefore, there is a need to standardize the processes of preparing traditional dairy products, which would require lesser preparation time. Many preparations of convenience foods for various milk based products are available in the market which can be used very easily [3].

However, limited efforts have been made for developing ready mix of different traditional milk products and literature available on the kheer-mix is very less, this work was conducted with an objective to development of instant kheer-mix.

Materials and methods
Whole milk powder (WMP) and skim milk powder (SMP) were procured from Mother Dairy and cane sugar was procured from local market, Hisar. Commercial grade broken basmati rice (HAFED, Haryana, India) were further ground to uniform size of 1 mm approximately. Commercial grade white crystalline cane sugar was ground to make into fine powder and used for formulation and the trials were conducted using WMP and SMP, separately. Sensory evaluation of kheer prepared from instant kheer-mix formulations was carried out separately for each group i. e. group A, B and C containing 10, 12.5 and 15 per cent rice respectively, with different treatments ($T_1 = 25$, $T_2 = 30$ and $T_3 = 35\%$) of sugar substituting whole milk and skim milk powders, separately (Table 1) to select the best formulation.

Preparation of kheer
Kheer was reconstituted from instant kheer-mix (100g) having different combinations of ingredients (table 1) with adding about 600 ml of water which was about to boil, to obtain a desired consistency [4]. Continuous stirring was done while adding kheer-mix to the water. The mixture was kept at simmering temperature over a low fire with constant stirring to avoid scorching. Cooking was continued for 10 to 15 min.

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After achieving desired consistency the kheer was immediately cooled to room temperature with continuous stirring to avoid skin formation and stored till it was served to the panel of judges for sensory evaluation.

Organoleptic evaluation of kheer
Organoleptic evaluation of kheer in respect of colour and appearance, flavor, body and texture and overall acceptability was carried out by a panel of 6 judges. The judges were asked to evaluate the product by using score card comprising of '9' point hedonic scale as described in 'Manual of Analysis of Fruit and Vegetable products' by Ranganna [5].

Table 1: Treatment combinations of ingredients used for development of instant kheer-mix

Groups	Treatments	Proportion of ingredients (%)					
		Whole Milk Powder			Skim Milk Powder		
		Rice	Sugar	MP	Rice	Sugar	MP
A	AT_1	10	25	65	10	25	65
	AT_2	10	30	60	10	30	60
	AT_3	10	35	55	10	35	55
B	BT_4	12.5	25	62.5	12.5	25	62.5
	BT_5	12.5	30	57.5	12.5	30	57.5
	BT_6	12.5	35	52.5	12.5	35	52.5
C	CT_7	15	25	60	15	25	60
	CT_8	15	30	55	15	30	55
	CT_9	15	35	50	15	35	50

A = 10% Rice,   B = 12.5% Rice,   C = 15% Rice
T_1 = 25% sugar + 65% MP, T_2 = 30% sugar + 60% MP, T_3 = 35% sugar + 55% MP,
T_4 = 25% sugar + 62.5% MP, T_5=30% sugar + 57.5% MP, T_6 = 35% sugar + 52.5% MP
T_7 = 25% sugar + 65% MP, T_8 = 30% sugar + 60% MP, T_9 = 35% sugar + 55% MP

Statistical analysis
The experiment was repeated thrice in duplicate and the results were analyzed using completely randomized design as per Snedecor and Cochran [6]. The data were subjected the statistical analysis using SPSS MAC, version 22.0, SPSS Chicago (USA).

Results and discussion
Results of whole milk powder based group-A (10% rice) showed that sensory score for colour and appearance was decreased as the level of sugar was increased (Table 2). Sensory scores for flavour (7.80) and overall acceptability (7.55) were the highest for AT_2 treatment and were significantly superior over those of AT_1 (7.25, 7.00) and AT_3 (6.55, 6.60) treatments, respectively. The sensory score for body and texture was also highest (7.30) for AT_2 but was at par with that of AT_1 (6.80) and significantly superior over that of AT_3 treatment (6.20). The results indicate that AT_2 treatment is superior over AT_1 and AT_3 treatment.

Table 2: Sensory evaluation of different reconstituted instant kheer-mix based on whole milk powder (n=6)

Groups	Treatments	Colour and appearance	Flavour	Body and texture	Over all acceptability
A	AT_1	$7.80^a \pm 0.31$	$7.25^b \pm 0.12$	$6.80^a \pm 0.50$	$7.00^b \pm 0.80$
	AT_2	$7.30^a \pm 0.60$	$7.80^a \pm 0.55$	$7.30^a \pm 0.75$	$7.55^a \pm 0.43$
	AT_3	$6.60^b \pm 0.12$	$6.55^c \pm 0.34$	$6.20^b \pm 0.40$	$6.60^c \pm 0.50$
B	BT_4	$7.65^a \pm 0.44$	$7.25^b \pm 0.60$	$7.00^b \pm 0.63$	$6.98^b \pm 0.5$
	BT_5	$7.50^a \pm 0.38$	$8.00^a \pm 0.44$	$7.95^a \pm 0.81$	$7.88^a \pm 0.10$
	BT_6	$7.00^b \pm 0.46$	$7.45^b \pm 0.72$	$7.45^b \pm 0.54$	$7.35^b \pm 0.74$
C	CT_7	$7.70^a \pm 0.45$	$7.55^b \pm 0.44$	$7.10^a \pm 0.42$	$7.20^b \pm 0.41$
	CT_8	$7.70^a \pm 0.45$	$7.75^a \pm 0.44$	$7.15^a \pm 0.42$	$7.70^a \pm 0.41$
	CT_9	$7.05^b \pm 0.77$	$7.00^c \pm 0.54$	$6.50^b \pm 0.50$	$7.00^b \pm 0.66$

Means ± SE with different superscripts in column with in a group differ significantly ($0 \leq 0.5$)
A = 10% Rice,   B = 12.5% Rice,   C = 15% Rice
T_1 = 25% sugar + 65% WMP T_2 = 30 sugar % + 60% WMP, T_3 = 35% sugar + 55% WMP
T_4 = 25% sugar + 62.5% WMP, T_5 = 30% sugar + 57.5% WMP, T_6 = 35% sugar + 52.5% WMP
T_7 = 25% sugar + 65% WMP, T_8 = 30% sugar + 60% WMP, T_9 = 35% sugar + 55% WMP

From the results of group-B (12.5% rice), it is clear that sensory score for colour and appearance of BT_4 treatment was the highest (7.65) but was at par with that of BT_5 treatment (7.50) and significantly superior over that of BT_6 treatment (7.00). The sensory scores for body and texture, flavor and overall acceptability of BT_5 treatment were 7.95, 8.00, and 7.88, respectively, which were higher than the corresponding scores of other two treatments. Further it is seen that these scores of BT_5 treatment were significantly superior to BT_4 and BT_6 treatments.
It is revealed from the results of group - C (15% rice) that the scores for colour and appearance, of CT_7 and CT_8 treatments were similar with each other and were significantly superior to that of CT_9 treatment. The highest scores were recorded for flavour (7.75) and overall acceptability (7.70) of CT_8 treatment and these scores were significantly superior to the scores for CT_7 and CT_9 treatments. The similar effect of increase in sugar and decrease in whole milk powder concentration level was also reported by Kadam et al. [4] on sensory scores of kheer ready-mix.
Table 2 revealed that the whole milk powder based instant kheer mix reconstituted with BT_5 treatment was highly acceptable by the panelists.
Results of skim milk powder based group-A (10% rice)

showed that sensory score for colour and appearance were statistically similar initially but further increase of sugar level decreased the colour scores significantly (Table 3). Sensory scores for flavour (7.35) and overall acceptability (7.25) were the highest for AT_1 treatments and were significantly superior over those of AT_2 (6.20, 6.51) and AT_3 (6.85, 6.98)

treatments, respectively. The sensory score for body and texture was also highest (6.70) for AT_1 but was at par with that of AT_3 (6.35) and significantly superior over that of AT_2 treatment (5.70). The results indicate that over all acceptability score of AT_1 and AT_3 treatments were statistically similar.

Table 3: Sensory evaluation of different reconstituted instant kheer-mix based on skim milk powder (n=6)

Groups	Treatments	Colour and appearance	Flavour	Body and texture	Over all acceptability
A	AT_1	$7.70^a \pm 0.19$	$7.35^a \pm 0.63$	$6.70^a \pm 0.91$	$7.25^a \pm 0.83$
	AT_2	$7.60^a \pm 0.95$	$6.20^b \pm 0.40$	$5.70^b \pm 0.55$	$6.51^b \pm 0.50$
	AT_3	$6.99^b \pm 0.30$	$6.85^a \pm 0.44$	$6.35^a \pm 0.17$	$6.98^{ab} \pm 0.90$
B	BT_4	$7.30^b \pm 0.60$	$6.95^b \pm 0.60$	$6.95^b \pm 0.60$	$7.06^c \pm 0.60$
	BT_5	$7.50^{ab} \pm 0.90$	$7.60^a \pm 0.33$	$7.20^{ab} \pm 0.50$	$7.33^{ab} \pm 0.22$
	BT_6	$7.80^a \pm 0.48$	$8.00^a \pm 0.50$	$7.60^a \pm 0.40$	$7.80^a \pm 0.46$
C	CT_7	$7.00^a \pm 0.77$	$6.90^b \pm 0.62$	$6.80^b \pm 0.60$	$6.90^b \pm 0.57$
	CT_8	$7.24^a \pm 0.64$	$7.35^{ab} \pm 0.45$	$7.85^a \pm 0.44$	$7.35^{ab} \pm 0.50$
	CT_9	$6.95^a \pm 0.56$	$7.60^a \pm 0.66$	$7.50^a \pm 0.50$	$7.48^a \pm 0.54$

Means ± SE with different superscripts in column with in a group differ significantly (0 ≤ 0.5)
A = 10% Rice, B = 12.5% Rice, C = 15% Rice
T_1 = 25% sugar + 65% SMP, T_2 = 30% sugar + 60% SMP, T_3 = 35% sugar + 55% SMP
T_4 = 25% sugar + 62.5% SMP, T_5 = 30% sugar + 57.5% SMP, T_6 = 35% sugar + 52.5% SMP
T_7 = 25% sugar + 65% SMP, T_8 = 30% sugar + 60% SMP, T_9 = 35% sugar + 55% SMP

From the results of skim milk powder based group-B (12.5% rice), it revealed that sensory score for colour and appearance of BT_6 treatment was the highest (7.80) but was at par with that of BT_5 treatment (7.50) and significantly superior over that of BT_4 treatment (7.30). The sensory scores for body and texture, and flavor of BT_6 treatment were higher than the corresponding scores of other two treatments (BT_4 and BT_5). Further it is seen that overall acceptability scores of BT_6 treatment was highest (7.80) and significantly superior to BT_4 and BT_5 treatments.
Skim milk powder based group-C (15% rice) showed that the scores for colour and appearance, of CT_7, CT_8 and CT_9 treatments were similar with each other. The highest scores were recorded for flavour (7.60) and overall acceptability

(7.48) of CT_9 treatment and these scores were significantly superior to the scores for CT_7 treatment.
Table 3 revealed that the skim milk powder based instant kheer mix reconstituted with BT_6 treatment was highly acceptable by the panelists. Similar report for ready kheer-mix prepared with SMP are also documented by Singla [7].
Kheer-mix based on WMP (BT_5) showed significantly higher fat (16%) and protein content with lower carbohydrates than SMP based (BT_6) kheer-mix (Table 4). Moisture in powders is an important property, which affects their shelf life and also flow properties. The moisture content of the kheer mix was less than 4%, on the lower side of the range, viz. 2–4% reported for whole milk powder [8]. These results are in accordance with findings of Singla [7] and Jha et al. [8] and

Table 4: Proximate composition of selected instant kheer-mix (n=6)

Parameters (%)	WMP (BT_5)	SMP (BT_6)
Moisture	$2.41^a \pm 0.60$	$3.61^b \pm 0.14$
Protein	$20.30^a \pm 1.14$	$19.90^a \pm 1.10$
Fat	$16.00^b \pm 0.10$	$1.16^a \pm 0.17$
Ash	$3.03^a \pm 0.16$	$3.88^b \pm 0.09$
Carbohydrate	$58.26^a \pm 0.33$	$71.45^b \pm 0.18$

Means ± SE with different superscripts in a row differ significantly (0≤0.5)
WMP = whole milk powder, BT_5 = 12.5% Rice + 30% sugar + 57.5% WMP
SMP = Skim milk powder, BT_6 = 12.5% Rice + 35% sugar + 52.5% SMP

Conclusions
Whole Milk Powder (57.5%) based reconstituted kheer with sugar (30%) and rice (12.5%) from Table 2 (BT_5), and Skim Milk Powder (52.5%) with sugar (35%) and rice (12.5%) from Table 3 (BT_6) were highly acceptable by the panelists. It is concluded that SMP (52.5%) based kheer-mix with 35% sugar and 12.5% rice is recommended for consumers preferring low fat diets.

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