



## Development and sensory evaluation of *Kheer* prepared from little millet (*Kutki*), milk and honey from *Melghat*

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### Abstract

*Melghat* is a tribal region of district *Amravati* of the state of *Maharashtra*. Malnutrition among children is a burning issue in the area. The gigantic forest is a large producer of wild honey. *Kutki* (little millet), a kind of millet, is also cultivated for years in the region *Melghat*. Both the materials are reported to have tremendous nutritional properties. In the current study, an attempt was made to prepare the traditional sweet dish *Kheer* by using milk, *kutki* grains, and honey to standardize a novel recipe. The *Kheer* samples were prepared by adding a varied amount of honey collected from four distinct locations of *Melghat*. *Kheer* samples were checked for its quality by using the techniques of sensory evaluation. The data were analyzed by using ANOVA. The recipe was standardized from the results. It was observed that the recipe was found successful and honey was accepted for sweetening the *Kheer* to a considerable extent. The *Kheer* prepared from locally available *Kutki*, milk, and honey may be considered as a useful supplementary food to overcome the issue of malnutrition.

**Keywords:** honey, *Kheer*, *Kutki*, little millet, malnutrition, *Melghat*

### Introduction

*Melghat* is a province with a tribal population that is located in the laps of the *Satpuda* hills. The area is comprised of two sanctuaries and a National Park within two tehsils (*Chikhaldara* and *Dharni*) of the *Amravati* district. Malnutrition among children is the prime issue of the region. Many children have died and are still dying due to undernourishment. Poverty and consumption of a diet with low nutritional value are some of the basic reasons behind the issue of malnutrition. In addition, while choosing the food its nutritional value, a key element that affects the health of an individual is not considered to that extent. Choosing nutritionally adequate food can be helpful to fight malnutrition (Singh & Singh, 2008; MTR Buffer Plan, 2015; Birdi et al., 2014) [18]. It was reported in many studies that because of the lack of awareness some nutritionally excellent crops such as millets are ignored and not used much by the people. Millets are the oldest crops that were cultivated largely for some years. The fact is that they are given the name 'Nutri-cereals' because of their excellent nutritional potential (NAAS, 2013; Rao et al., 2018) [10].

### *KUTKI* (Little Millet)

Millets are non-gluten grains with great nutritional potential and economical excellence. They are high in fat, protein, and minerals than other common cereals (Kamtar et al., 2013; Sivakumar et al., 2006) [19]. Sorghum and *bajra* are some popular millet used predominantly. The minor millet such as *Kutki* (little millet or *Panicum sumatrense*), grown in the *Melghat* province, needs the necessary exposure for its use. Though it is a native Indian crop, very little research work was found to be done regarding the study of *Kutki*. The group of minor millets can withstand extreme environmental conditions that may be harmful to other popular crops (Padulosi et al., 2015; Sarita & Singh, 2016)

[11]. Moreover, minor millets are considered to be the cheap sources of protein, B vitamins, fibers, energy, and plenty of minerals especially iron (Hemalatha et al., 2006) [4]. They can produce a high yield of biomass in a comparatively short duration thus may be termed bio-energy crops (Rao et al., 2017) [13].

### Honey

Honey is one of the important natural food products with tremendous nutritional and medicinal properties. It shows high antioxidant potential and antimicrobial activities (Khan et al., 2018; Saad et al., 2017) [15]. Honey is an important forest product of the *Melghat*, mostly created by the wild forest bees such as *Apis cerana indica* or *Apis dorsata* (Honey Mission, 2018). Due to the tremendous biodiversity of the forest region and availability of a variety of flowers throughout the year, the atmosphere is extremely favorable for the nourishment of the bees and consequentially for the production of good quality honey (Deshmukh, 2012; KVIC, 2019) [3, 8]. This study is dealing with the preparation of nutritious *Kheer* by using local ingredients such as milk, *Kutki*, and honey. Traditionally *Kheer* is prepared by using milk and rice (Barela & Shelke, 2017) [1]. The use of locally available *Kutki* for the *Kheer* preparation may be proved as a novel recipe. Along with sugar, honey was used as an additional sweetener to increase the nutritional quality. The quality of the *Kheer* was checked for its acceptance at the varied amount of honey by using the technique of sensory evaluation.

### Materials and Methods

Structural type of research carried out for the study. The work was done in the months of Oct-Dec., 2019. For making the nutritional *Kheer*, *Kutki* and milk were collected from the local market. Four kinds of honey samples were

collected from different locations of the *Melghat*.

**Preparation of Kheer**

Milk (2 kg), *Kutki* grains (100g), sugar (300g), and honey (at different amounts) were the ingredients used for the preparation of the *Kheer*. Honey is used for multiple purposes i.e. for value addition, nutritional improvement, and promotion of local products. A total of 21 kinds of *Kheer* samples were prepared. Sugar was used as per requirement. The *Kheer* was prepared by using the traditional procedure (Fig.1). Milk, *Kutki* grains, sugar, and honey were the chief ingredients used.

*Kutki* grains were cleaned and soaked for two hours. The soaked grains were ground to get a coarse particle paste. Milk was boiled to reduce 20% of its volume and the *Kutki* paste was added. The mixture was boiled for another 10-15 minutes for the complete cooking of *Kutki* grains. Cardamom powder was added after cooling to room temperature. The formulation of *Kheer* and their code names are given in table I.

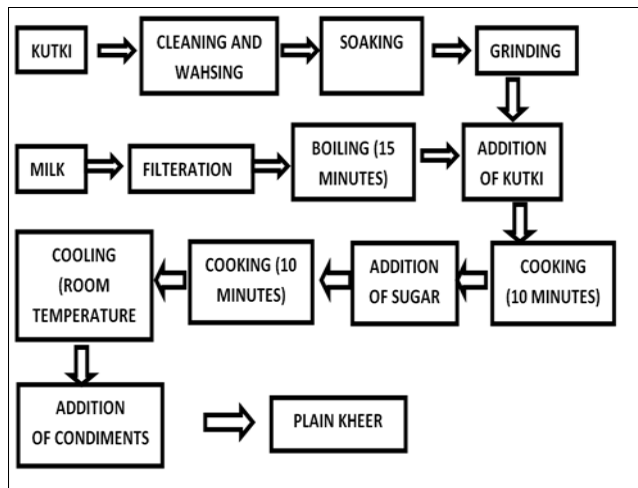


Fig 1: Flow chart for *kheer* production

Table 1: Code names of *kheer* samples

Honey amount	Code Names				Blank Without honey
	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	H <sub>4</sub>	
2 %	KH <sub>1a</sub>	KH <sub>2a</sub>	KH <sub>3a</sub>	KH <sub>4a</sub>	K <sub>B</sub>
4 %	KH <sub>1b</sub>	KH <sub>2b</sub>	KH <sub>3b</sub>	KH <sub>4b</sub>	
6 %	KH <sub>1c</sub>	KH <sub>2c</sub>	KH <sub>3c</sub>	KH <sub>4c</sub>	
8 %	KH <sub>1d</sub>	KH <sub>2d</sub>	KH <sub>3d</sub>	KH <sub>4d</sub>	
10 %	KH <sub>1e</sub>	KH <sub>2e</sub>	KH <sub>3e</sub>	KH <sub>4e</sub>	
Total <i>Kheer</i> Samples Prepared= 20					

**Sensory Evaluation**

For evaluating the quality of food products sensory evaluation technique is used as one of the tools. The quality of the product and the response of the end-user are dependent on each other. In the current study, the value-added product, i.e. *Kheer* was subjected to the sensory evaluation to determine its quality. A nine-point hedonic scale from extremely like to extremely dislike was applied. The panel of five semi-trained judges evaluated the samples based on their pleasurable and un-pleasurable experiences (Ranganna, 2007; Sharif et al., 2017) [12, 17].

**Statistical Analysis**

The sensory evaluation data obtained for the variety of

parameters are compared by using the one-way and two-way ANOVA techniques. The mean values are compared by using one-way ANOVA, while the summary of total scores of sensory evaluation for each product is compared by using two-way ANOVA (at significance level 0.5). The comparison is done separately for the values of evaluation of products honey type wise and amount wisely.

**Results and Discussion**

The results of the sensory evaluation tests are given in “Table II & IV”. The overall and average scores are given in “Table VI”.

As per “Table II and VI”, *Kheer* samples prepared by adding the honey H<sub>1</sub>, it was found that the *Kheer* with 4% honey (KH<sub>1b</sub>) was on the top with a score of 37. *Kheer* with honey 6% (KH<sub>1c</sub>) was on second (score 36) followed by the sample KH<sub>1a</sub> (score 33), KH<sub>1d</sub> (score 30), and at last KH<sub>1e</sub> (score 27). While the *Kheer* sample without honey (K<sub>B</sub>) scored 38 points. The scores increased previously i.e. up to 4% with the addition of honey, but with further addition of honey, the scores tended to decrease. If summarized it can be said that the *Kheer* samples prepared by adding honey one (H<sub>1</sub>) were liked by the judges to a smaller extent (mean score 6.6). The overall total and average scores for the *Kheer* samples with honey one were 163 and 32.6 respectively which were much below the blank.

The *Kheer* samples prepared from the honey two (KH<sub>2</sub>) scored higher points than the samples KH<sub>1</sub>. The highest score that was obtained in this category was 39 for the *Kheer* prepared with 6% of honey (KH<sub>2c</sub>). The scores were found to be decreased for their values on both sides of KH<sub>2c</sub>. The sample KH<sub>2b</sub> got a score of 38 while KH<sub>2a</sub> was at 36 followed by KH<sub>2d</sub> (score 33) and KH<sub>2e</sub> (score 31). The *Kheer* samples prepared with the honey (H<sub>2</sub>) were liked more than that of the *Kheer* samples KH<sub>1</sub>. The mean score was 35.2 lower than that of the blank. The total and mean scores obtained by the *Kheer* samples prepared from honey two were having the highest scores (score 176) among all the other honey *Kheer* samples.

In the case of *Kheer* samples with honey 3, the *Kheer* with honey at an amount of 4% (KH<sub>3b</sub>) was at the top, followed by the sample KH<sub>3c</sub> (score 35), KH<sub>3a</sub> (score 33), KH<sub>3d</sub> (score 31), and lastly KH<sub>3e</sub> (score 28).

The highest value in this category was 39 i.e. for the *Kheer* with 4% honey (KH<sub>3b</sub>), which was greater than the blank and equal to the highest score got by the *Kheer* KH<sub>2c</sub>. The overall total score was 166 which was less than the *Kheer* samples KH<sub>2</sub> and more than KH<sub>1</sub>. The average score was 33.2 that was much less than the blank.

The scores for the *Kheer* samples from honey four (KH<sub>4</sub>) were somewhat higher than that of the *Kheer* samples with honey one and three. The highest score (score 38) in this category was for the *Kheer* with honey at an amount of 6% (KH<sub>4c</sub>). The sample KH<sub>4b</sub> was at second position with a score of 36 followed by KH<sub>4a</sub> (score 35), KH<sub>4d</sub> (score 32), and KH<sub>4e</sub> (score 29). The average score in this category was 34 which was also lesser than the blank but was in the second position after the *Kheer* samples with honey two (KH<sub>2</sub>).

Thus it was observed that the scores of the *Kheer* with honey H<sub>2</sub> were at the top according to the choice of the panel of judges in the sensory evaluation. It got a total overall score of 176 with an average of 35.2 in all the categories of varying amounts of honey. The *Kheer* samples

prepared with honey two were at the top of the list in four categories i.e. in the Kheer with 2% honey, 6% honey, 8% honey, and 10% honey, while it was in the second position in the category of Kheer with 4% honey.

From the statistical analysis ANOVA “Table III” it is concluded that the mean values that the parameters showed considerable differences with the change in the honey samples ( $F_{cal} > F_{crit}$  i.e.  $6.38 > 3.06$ ).

Thus, according to the sensory evaluation tests, it was concluded that the honey samples from location 2 were found most suitable for the addition in the Kheer. The Kheer samples with honey from location four i.e. KH<sub>4</sub> were in the second position with an overall score of 170. Though they were not on the top of any individual category, consistently were on the second position in the four categories, i.e. Kheer with honey at the rate of 2%, 6%, 8%, and 10%. The average mean score by the Kheer with honey sample four was calculated as 34. The Kheer samples with honey three were in the third position and with honey one were at the bottom of the table. The overall mean scores for all the

Kheer samples with honey from various locations were ranging between 32.6 and 35.2. It was a very narrow range so it could be said that all the honey samples were accepted by the judges for use in Kheer as the total score for blank was slightly higher than this range.

As per the amount of honey that is suitable for addition in the Kheer is concerned, it was clear from the data “Table IV & VI” that the sensory evaluation scores for the samples with honey at the rate of 4% were on the top (with a total overall score of 149 and a mean of 37.25) and the scores for the samples with honey at the rate of 6% were at second position with nearly equal values (total overall score 148 and mean 37). “Table V” showed that the scores for each parameter varies considerably as the amount of the honey added was changed ( $F_{cal} < F_{crit}$  i.e.  $1.034 < 2.866$ ).

The Total scores were also analyzed using two-way ANOVA “Table VII”. It is concluded that the total score of sensory evaluation for the kheer prepared with different types of honey samples at different amounts shows the variation in their scores for sensory properties.

**Table 2:** Sensory evaluation data for *kheer* (honey wise)

Honey Type	Amount	Sensory Attributes						
		Color	Texture	Taste	Appearance	OA	Total	Mean
H1	2%	7	6	7	7	6	33	6.6
	4%	7	7	8	7	8	37	7.4
	6%	7	7	8	7	7	36	7.2
	8%	6	6	7	5	6	30	6.0
	10%	6	5	6	5	5	28	5.4
	Mean	6.6	6.2	7.2	6.2	6.4	32.6	6.52
	SD	0.55	0.84	0.84	1.09	1.14		0.83
H2	2%	7	7	7	8	7	36	7.2
	4%	7	7	8	7	8	37	7.4
	6%	7	7	9	8	8	39	7.8
	8%	6	7	8	6	6	33	6.6
	10%	6	6	7	6	6	31	6.2
	Mean	6.6	6.8	7.8	7.0	7.0	35.2	7.04
	SD	0.55	0.45	0.84	1	1		0.64
H3	2%	7	6	7	7	6	33	6.6
	4%	8	8	8	7	8	39	7.8
	6%	7	6	8	7	7	35	7.0
	8%	6	6	7	6	6	31	6.2
	10%	6	5	6	6	5	28	5.6
	Mean	6.8	6.2	7.2	6.6	6.4	33.2	6.64
	SD	0.84	1.09	0.84	0.55	1.14		0.83
H4	2%	6	7	7	8	7	35	7.0
	4%	7	7	8	7	7	36	7.2
	6%	7	7	8	8	8	38	7.6
	8%	6	7	7	6	6	32	6.4
	10%	6	6	7	5	5	29	5.8
	Mean	6.4	6.8	7.4	6.8	6.6	34	6.8
	SD	0.55	0.45	0.55	1.30	1.14		0.71

**Table 3:** One way ANOVA (Honey wise)

Sensory attributes	Mean values			
	KH <sub>1</sub>	KH <sub>2</sub>	KH <sub>3</sub>	KH <sub>4</sub>
Color	6.6	6.6	6.8	6.4
Texture	6.2	6.8	6.2	6.8
Taste	7.2	7.8	7.2	7.4
Appearance	6.2	7	6.6	6.8
OA	6.4	7	6.4	6.6
SUMMARY				
Groups	Count	Sum	Average	Variance
Color	4	26.4	6.6	0.027
Texture	4	26	6.5	0.12

Taste	4	29.6	7.4	0.08		
Appearance	4	26.6	6.65	0.117		
OA	4	26.4	6.6	0.08		
ANOVA (ONE-FACTOR)						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	2.16	4	0.54	6.38	0.0033	3.06
Within Groups	1.27	15	0.085			
Total	3.43	19				

**Table 4:** Sensory evaluation data for *kheer* (Honey amount wise)

Added amount of honey	Honey	Sensory Attributes						
		Color	Texture	Taste	Appearance	OA	Total	Mean
2%	H1	7	6	7	7	6	33	6.6
	H2	7	7	7	8	7	36	7.2
	H3	7	6	7	7	6	33	6.6
	H4	6	7	7	8	7	35	7.0
	Mean	6.75	6.5	7	7.5	6.5	34.25	6.85
	SD	0.50	0.58	0	0.58	0.58		0.30
4%	H1	7	7	8	7	8	37	7.4
	H2	7	7	8	7	8	37	7.4
	H3	8	8	8	7	8	39	7.8
	H4	7	7	8	7	7	36	7.2
	Mean	7.25	7.25	8	7	7.75	37.25	7.45
	SD	0.50	0.50	0	0	0.50		0.25
6%	H1	7	7	8	7	7	36	7.2
	H2	7	7	9	8	8	39	7.8
	H3	7	6	8	7	7	35	7.0
	H4	7	7	8	8	8	38	7.6
	Mean	7	6.75	8.25	7.5	7.5	37	7.4
	SD	0	0.50	0.50	0.58	0.58		0.37
8%	H1	6	6	7	5	6	30	6
	H2	6	7	8	6	6	33	6.6
	H3	6	6	7	6	6	31	6.2
	H4	6	7	7	6	6	32	6.4
	Mean	6	6.5	7.25	5.75	6	31.5	6.3
	SD	0	0.58	0.5	0.5	0		0.26
10%	H1	6	5	6	5	5	27	5.4
	H2	6	6	7	6	6	31	6.2
	H3	6	5	6	6	5	28	5.6
	H4	6	6	7	5	5	28	5.8
	Mean	6	5.5	6.5	5.5	5.25	28.75	5.75
	SD	0	0.58	0.58	0.58	0.5		0.34

**Table 5:** One way ANOVA (Honey amount wise)

Sensory attributes	Mean values					
	2%	4%	6%	8%	10%	
Color	6.75	7.25	7.00	6.00	6.00	
Texture	6.50	7.25	6.75	6.50	5.50	
Taste	7.00	8.00	8.25	7.25	6.50	
Appearance	7.50	7.00	7.50	5.75	5.50	
OA	6.50	7.75	7.50	6.00	5.25	
SUMMARY						
Groups	Count	Sum	Average	Variance		
Color	5	33	6.6	0.33		
Texture	5	32.5	6.5	0.41		
Taste	5	37	7.4	0.52		
Appearance	5	33.25	6.65	0.925		
Overall Acceptability	5	33	6.6	1.081		
ANOVA (ONE-FACTOR)						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.7	4	0.675	1.034	0.414	2.866
Within Groups	13.05	20	0.652			
Total	15.75	24				

**Table 6:** Combined data of sensory evaluation

Kheer Samples	Total combined scores						Total	Mean
	2%	4%	6%	8%	10%			
KH <sub>1</sub>	33	37	36	30	27	163	32.6	
KH <sub>2</sub>	36	37	39	33	31	176	35.2	
KH <sub>3</sub>	33	39	35	31	28	166	33.2	
KH <sub>4</sub>	35	36	38	32	29	170	34.00	
Total	137	149	148	126	115	675	135.0	
Mean	34.25	37.25	37.00	31.50	28.75	168.75	33.75	

**Table 7:** Two-way ANOVA for total scores

Kheer Samples	Total scores of sensory evaluation					
	2%	4%	6%	8%	10%	
KH <sub>1</sub>	33	37	36	30	27	
KH <sub>2</sub>	36	37	39	33	31	
KH <sub>3</sub>	33	39	35	31	28	
KH <sub>4</sub>	35	36	38	32	29	
Summary						
Summary	Count	Sum	Average	Variance		
KH <sub>1</sub> (Row 1)	5	163	32.6	17.3		
KH <sub>2</sub> (Row 2)	5	176	35.2	10.2		
KH <sub>3</sub> (Row 3)	5	166	33.2	17.2		
KH <sub>4</sub> (Row 4)	5	170	34	12.5		
2% (Column 1)	4	137	34.25	2.25		
4% (Column 2)	4	149	37.25	1.58		
6% (Column 3)	4	148	37	3.33		
8% (Column 4)	4	126	31.5	1.667		
10% (Column 5)	4	115	28.75	2.92		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows	18.95	3	6.317	4.65	0.022	3.49
Columns	212.5	4	53.13	39.11	8.59E-07	3.26
Error	16.3	12	1.358			
Total	247.75	19				

**Conclusion**

It could be postulated that the *Kheer* samples with honey at the rate of 4% and 6% were highly accepted by the judges, comparably it was found that the *Kheer* samples with honey at the rate of 2%, 8%, and 10% were not liked by the judges up to that extent as the differences were significantly high than the top scores. The overall scores for the *Kheer* samples with 2% honey, 8% honey, and 10% honey were 137 (mean 34.25), 126 (mean 31.5), and 115 (mean 28.75) respectively.

Therefore, *Kutki* grains were found suitable for the preparation of *Kheer*. The incorporation of honey as an additional sweetener was liked by the judges significantly. Honey at the rate of 4% and 6% was found most suitable. The honey at a higher amount was not accepted to that extent may be due to the stickiness and a typical flavor of the honey.

Thus, the *Kheer* prepared by using nutritionally potent raw materials such as *Kutki*, milk, and honey might help maintain the good health of the children of the *Melghat* and can work towards solving the problem of malnutrition. Still, more work is needed for the study of honey and *Kutki* of *Melghat* and for the preparation of more value-added products to build the brand *Melghat*.

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