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FORMULATION, STANDARDIZATION AND QUALITY EVALUATION OF RICE VERMICELLI PREPARED FROM FLOOD AFFECTED PADDY

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ABSTRACT

Rice is a major component of the agricultural sector in particular and the overall economy in general. Rice is one of the most important staple food for more than half of the world's population and influences the livelihood and economies of several billion people. Paddy loss due to flooding in Bangladesh and India alone amounts to an estimated 4.0 million tons per year enough to feed 30 million people. Over 20% of rice land in Bangladesh is prone to floods which occur every year (IRRI 2010). Such produce is often sold at low price causing economical loss to the farmers. Value added producti.e., rice vermicelli in combination with rice and sorghum at three different levels (as 100:0, 75:25 and 50:50)was formulated and evaluated for quality and storage stability. Statistically significant difference at P<0.05 in L* a* b* values was observed between the rice vermicelli samples. The lightness (L*) value of control samples showed more towards whiteness (100) compared to experimental samples. The a* (Hue) value of experimental samples showed more towards redness (+a* value) compared to control samples. The b* (brightness) value for all the samples was towards yellowness (+b* value). Statistically significant difference was observed in the mean scores for the sensory properties for kheer such as taste and texture at P< 0.05 level between the vermicelli prepared with normal and flood affected rice and also in all the three variations studied before and after storage for a period of 60 days. However, there was no significant difference in other sensory parameters such as colour, appearance, flavor and overall quality of the kheerwith in the treatments, between the treatments and between the storage periods for 60 days. The value added product i.e., kheer prepared with both normal and flood affected rice gave good result before storage and after stored for a period of 60 days without deteriorative changes in the sensory properties. Therefore, it can be concluded that flood affected paddy can be utilized for the development of value added products. Further extensive research is needed for the utilization of paddy for the production of more feasible and convenient products in order to minimize the losses in flood affected paddy.

INTRODUCTION

Rice is the major component of agriculture sector in particular and the overall economy in general. The suddenly occurred floods and over rainfall at matured state of paddy field causes much losses to the farmer and it poses significant portion of the human beings to hunger directly or indirectly. Therefore, value addition to flood affected paddy contribute significantly to national economy and helps paddy farmers from distress sale.The moistened paddy due to floods undergoes deteriorative changes i.e. low head rice yield (HRY), poor physico-chemical, nutritional, sensory and organoleptic quality changes.Rice kernel with 3/4th or more of their original length after complete milling operation is termed as head rice (USDA, 1983). The price of head rice is almost double or triple as compared to that of the broken kernels. Significant breakage during milling occurs when rice kernels have previously been weakened by stress cracks (fissures) caused by rapid moisture adsorption. These fissured kernels usually break during subsequent hulling and milling operations which results in reduced head rice yields. Such produce is often sold at low price causing economical loss to the farmers, especially small and marginal farmers. It does not offer any value-added benefit or incorporate available technology in ways to improve their value. Rice is a hygroscopic grain that will readily gain or lose moisture when exposed to varying environments.

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Moisture changes can induce tensile and compressive stresses within the kernel and often lead to stress crack development. Moisture adsorption is associated with water re-entering the grain. This occurs when the vapor pressure at the surface of a grain is lower than the vapor pressure in the surrounding air. The low moisture rice kernels fissure from rapid moisture adsorption was reported more than a half century ago by Kondo and Okamura (1930) and Stahel (1935).

Vermicelli

Nura *et al.* (2011) studied the Textural properties of laksa noodle as affected by rice flour particle size. The physicochemical properties of rice flours with five different particle sizes (≤63, 80, 100, 125, and 140 μm) prepared by dry milling and their effects on textural properties of laksa noodles was studied. Rice flour with the smallest particle size had the highest water absorption index, peak viscosity, hot pasteviscosity, breakdown, final or cold paste viscosity and gel hardness, but the lowest gelatinization temperature. Reduction of rice flour particle size improved textural properties of laksa noodle. Thus it was demonstrated that Laksa noodle produced fromrice flour with the smallest particle size had the best textural properties.Extrusion cooking is a continuous process with high production capacity, versatility and low cost. In general rice noodles were judged based on their uniformity, cooking and eating quality. Chanpen *et al.* (2008) studied the effect of processing conditions and the use of modified starch and monoglyceride on the properties of extruded rice vermicelli. Pasting profile and gel appearance of rice flour, rice flour mixed with the modified starch, MYK-500T and monoglyceride, Monomul 90-35P were examined. The rice noodle had white color, good retention of shape but stuck together after cooking. The use of modified starch, and monoglyceride reduced the stickiness of the product. The noodle extruded from rice flour added with MYK-500T (4 g/100 g blend) and Monomul 90-35P (1 g/100 g blend) was firm and not sticky, showing cooking time at 2 min, cooking weight 315 g/100 g of dry noodle, cooking loss 11.1 g/100 g of dry noodle and 88.9% degree of gelatinization . The hardness of the product was 1230 g and tensile strength 9.5 g. Sensory evaluation showed that the acceptance of the extruded rice vermicelli was not significantly different from other 3 commercial products prepared by conventional method.

Papotto *et al.* (1983) explained the preparation of rice noodles by using dry rice flour. In this study the rice flour was pre-moistened to 35.0%, 37.5% and 40.0% before extruded through a single screw extruder and dipped into hot water (95°C) for 15 sec. Rice flour with moisture of 35 % was the best when compared to that of the remaining 37.5 % and 40 % moisture flour. Sakol *et al.* (2005) demonstrated that the product quality of noodle and vermicelli improved by using modified starch and emulsifier. Modified starch type MYK 500-T 4% and emulsifier, monoglyceridemonomul 90-35 P 1.00%, were added to the rice flour, the product showed cooking weight at 315.68%, cooking loss 11.10% and final moisture content 8.72%. The hardness of the product was 1,230.25 g and tensile strength 9.50 g. The acceptance of extruded rice vermicelli was not significantly different from commercial rice vermicelli obtained by traditional process.

Therefore, there is a need to develop value added products with rice. Several commercial value added extruded products, health drink mixes etc. may serve the purpose. Vermicelli is a popular type of dish served in Asian countries in various forms as *upma, kheer, payasam*. *Paayasam* is a famous South Indian sweet dish made from vermicelli, which is prepared by using just vermicelli, milk, ghee, sugar, cardamom and dry fruits. Rice is the most consumed cereals globally owing to its versatility and suitability in the development of various traditional and new generation food products. The present study was undertaken as an exploration of the value added products from flood affected paddy that might prove to possess comparable good characteristics with that of normal paddy with the following objectives. To formulate, standardize the method for preparation of value added product i.e., vermicelli with rice and evaluation of its quality. Moreover, value added rice products as a substitute for imported wheat flour and wheat flour products can potentially save the country's valuable foreign exchange expenditure.

MATERIALS AND METHODS

Paddy was procured from the flood affected areas. Both normal paddy and flood affected paddy samples of same variety were procured from Raavulapaalem in West Godavari district of Andhra Pradesh. The paddy which was flood affected (submerged under water for almost three days at fully matured stage) was collected for the study. The study was carried out at Post Graduate and Research Centre (PGRC), Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad. The various ingredients used for preparation of the products and containers and packaging materials for preparation and storage of products were obtained from local market. All chemicals used in the investigation were food grade and analytical reagent (AR) grade chemicals and glassware which were obtained from Post Graduate and Research Centre (PG&RC).The collected paddy of both normal and flood affected were subjected to milling (Rice sheller-Indosaw) after drying to 14% moisture content (MC). Then they are made into flours.

Preparation of rice vermicelli

Vermicelli wasformulated and standardised with rice flour in combination with sorghum flour at three different levels (as 100:0, 75:25 and 50:50). The vermicelli was prepared with both normal rice and flood affected rice for which the normal rice was considered as control. Same procedure was followed for the preparation of rice vermicelli for all the above combinations. Cleaned rice was made in to rice flour. Rice flour and sorghum flour were taken as 100:0, 75:25 and 50:50 combinations. For all the three combinations 10 g guar gum, 65 ml water was added. All these ingredients were properly mixed then made into dough. The dough was extruded through small hand operated vermicelli making machine. Then the vermicelli collected trays are subjected to steam cooking and high temperature in hot air oven for uniform drying at 105 ° C (CINTEX Precision hot air oven). The dried vermicelli after cooling to room temperature was packed in polythene covers for storage. The procedure for preparation of vermicelli with flowchart is given below.

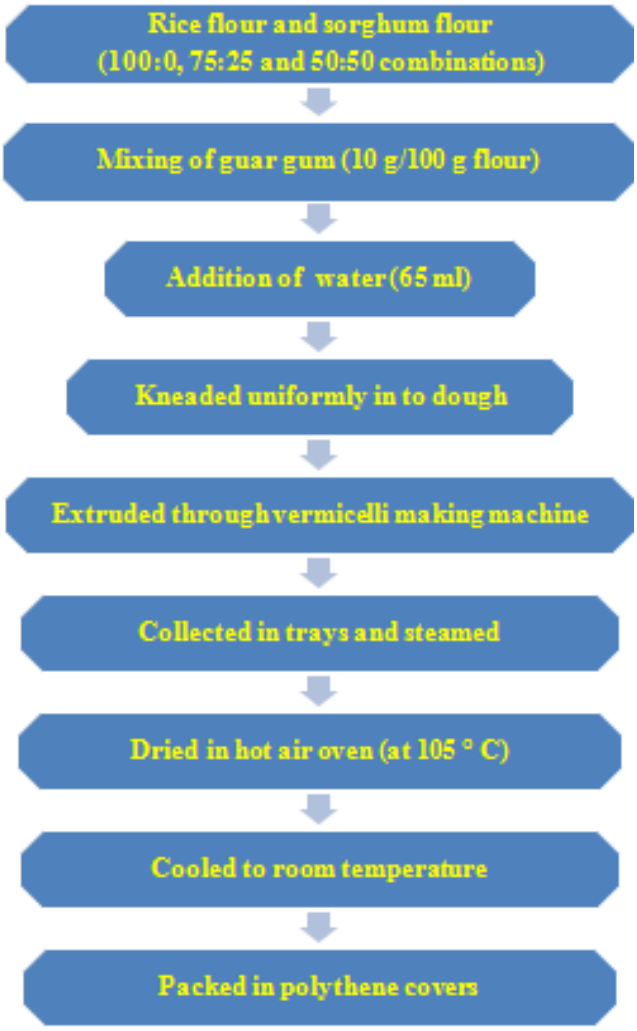

Fig. 1. Flow diagram for preparation of rice vermicelli

N1= Normal rice vermicelli -100:0 (Rice: Sorghum)
F1=Flood affected rice vermicelli -100:0 (Rice: Sorghum)
N2=Normal rice vermicelli -75:25 (Rice: Sorghum)
F2=Flood affected rice vermicelli -75:25 (Rice: Sorghum)
N3=Normal rice vermicelli -50:50 (Rice: Sorghum)
F3=Flood affected rice vermicelli -50:50 (Rice: Sorghum)

Fig. 2. Prepared rice vermicelli samples

Preparation of kheer from rice vermicelli

From the developed rice vermicelli, kheer was prepared. For the preparation the following ingredientswere used 100 g rice vermicelli, 120 g sugar, 4 tea spoon ground nut oil, 400 ml whole milk, 1000 ml water. First the vermicelli was roasted with small amount of oil and kept aside. Sugar, whole milk and water were uniformly mixed and heated up to 95° C then the roasted rice vermicelli was added to it and allowed to cook for 10 mins. Put off the stove and cooled to ambient temperature for serving.

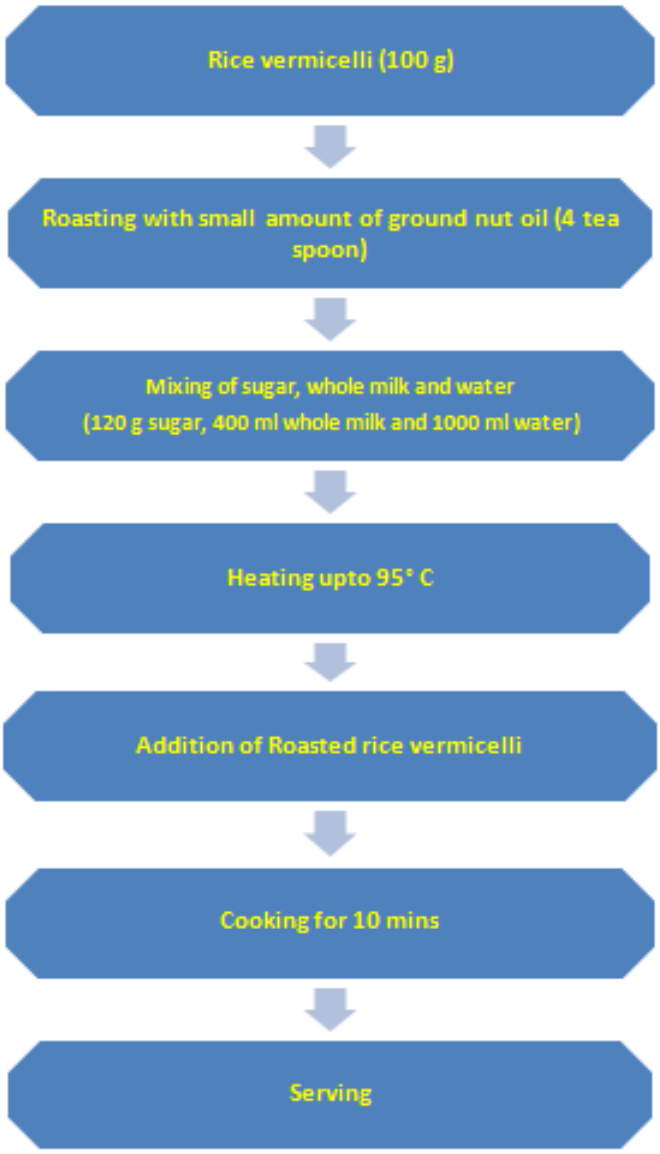

Fig. 3. Flow diagram for preparation of kheer rice from rice vermicelli

Sensory evaluation and storage stability of the developed value added productkheerrice

Rice vermicelli was studied for shelf life (sensory evaluation) for a period of 60 days. Ten tasters trained are used in the post graduate & research centre, Rajendranagar, Hyderabad for the sensory evaluation of the product named as kheerrice was prepared from rice vermicelli was done by 9 point hedonic scale. Samples were scored for colour, appearance, flavour, taste, texture and overall quality. Scores were based on a hedonic scale of 1 to 9 where: 1 = I dislike extremely (very bad) and 9 = I like extremely (excellent). (Amerine *et al.,*1965).

Statistical analysis of the data:

All the results werestatistically analysed to test the significance of the results using percentages, means, standard deviations and analysis of variance (ANOVA) technique. (Snedecor and Cochran 1983).

RESULTS AND DISCUSSION

Colour quality of rice vermicelli

The result of colour scores of normal rice vermicelli and flood affected rice vermicelli prepared at 3 different combinations with sorghum is mentioned in Table 1. The L* value of normal rice (control) vermicelli was higher (N1 - 72.44, N2 - 68.57 and N3-64.32 respectively) compared to flood affected rice (experimental)vermicelli (F1- 64.57, F2- 60.88 and F3- 59.14 respectively) in all the variations studied. From the above result it was observed that lightness (L*) value of control samples showed more towards whiteness (100) compared to experimental samples. Statistically significant difference at $P<0.05$ in L* values was observed between the samples.

The a* value of flood affected rice (experimental) vermicelli was higher (F1-0.60, F2-1.39 and F3-1.91 respectively) compared to normal rice (control) vermicelli (N1-0.42, N2-0.95 and N3-1.47 respectively) for all the variations studied. From the above result it was observed that a* value of experimental samples showed more towards redness (+a* value) compared to control samples. Statistically significant difference ($P<0.05$) in a* values was observed between the samples.

The b* valuefor normal rice (control) vermicelli was higher (N1-12.16, N2-14.52 and N3-15.85 respectively) compared to flood affected rice (experimental) vermicelli (F1-12.01, F2-13.73 and F3-14.36 respectively) for all the variations studied. The b* value for all the samples was towards yellowness (+b* value). Statistically significant difference at $P<0.05$ in b* values was observed between the samples.

Table 1.Colour scores of normal rice vermicelli and flood affected rice vermicelli in various proportions of rice and sorghum combinations

Rice vermicelli samples*	L* value	a* value	b* value
N1	72.44±0.08	0.42±0.08	12.16±0.13
F1	64.57±0.14	0.60±0.17	12.01±0.24
N2	68.57±0.20	0.95±0.22	14.52±0.15
F2	60.88±0.07	1.39±0.06	13.73±0.09
N3	64.32±0.22	1.47±0.45	15.85±0.39
F3	59.14±0.10	1.91±0.09	14.36±0.18
CD	0.263	0.401	0.395
SE (d)	0.119	0.182	0.180
SE (m)	0.084	0.129	0.127
CV	0.225	19.859	1.596

N1= Normal rice vermicelli -100:0 (Rice: Sorghum)
F1=Flood affected rice vermicelli -100:0 (Rice: Sorghum)
N2=Normal rice vermicelli -75:25 (Rice: Sorghum)
F2=Flood affected rice vermicelli -75:25 (Rice: Sorghum)
N3=Normal rice vermicelli -50:50 (Rice: Sorghum)
F3=Flood affected rice vermicelli -50:50 (Rice: Sorghum)

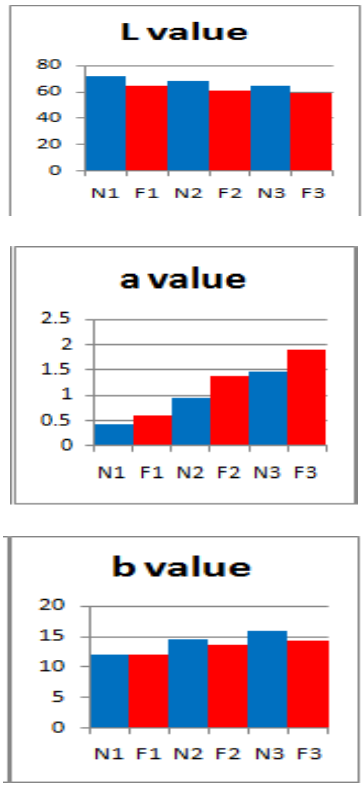

Fig. 4. Colour scores of normal rice vermicelli in comparison with flood affected ricevermicelli

Sensory evaluation and storage stability of the developed value added products

The product prepared from rice vermicelli was named as *kheer*. The *kheer* prepared with rice vermicelli was evaluated for sensory attributes before and after storage for a period of 60 days. The results of sensory analysis are mentioned in Table 2.The mean score for colour was maximum for N1 and F1 (8.2 and 8.0 respectively) and minimum for N3 and F3 (7.7 and 7.7 respectively) for the kheer before storage. The mean score for colour was maximum for N1 (7.9) and minimum for N3 (7.6) for the kheer prepared with normal rice. It was maximum for F1 and F2 (7.7) and minimum for F3 (7.6) in the kheer prepared with flood affected rice after storage for 60 days.

The mean score for appearance was maximum for N2 &N3 and F2 & F3 (7.9 and 7.9 respectively) and minimum for N1 and F1 (7.8 and 7.6 respectively) for the kheer before storage The mean score for appearance was maximum for for N2 &N3 and F2 & F3 (7.8 and 7.8 respectively) and minimum for N1 and F1 (7.6 and 7.4 respectively) after storage for 60 days.The mean score for flavour was maximum for N1 and F1 (7.8) and minimum for N3 and F3 (7.2) for the kheer before storage. The mean score for flavour was maximum for N1 and F1 (7.4) and minimum for N3 and F3 (7.0) for the kheerafter storage. The mean score for taste was maximum for N1 and F1 (8.1) and minimum for N3 and F3 (7.3) for the kheer before storge. The mean score for taste was maximum for N1 and F1 (7.9) and minimum for N3 and F 3 (7.0) for the kheerafter storage. The mean score for texture was maximum for N3 and F1 (7.8) and minimum for N1and F1 (6.9) for the kheer before storage.

Table 2. Mean sensory scores of *Kheer* rice prepared withrice vermicelli before and after storage

Sample	Colour		Appearance		Flavour		Taste		Texture		Overall quality	
	0^{th} day	60^{th} day	0^{th} day	60^{th} day	0^{th} day	60^{th} day	0^{th} day	60^{th} day	0^{th} day	60^{th} day	0^{th} day	60^{th} day
NI	8.2±0.63	7.9±0.74	7.8±0.42	7.6±0.70	7.8±0.63	7.4±0.70	8.1±0.57	7.9±0.57	6.9±0.74	6.5±0.71	7.8±0.79	7.5±0.53
F1	8.0±0.47	7.7±0.67	7.6±0.52	7.4±0.70	7.8±0.63	7.4±0.70	8.1±0.57	7.9±0.57	6.9±0.74	6.5±0.71	7.7±0.82	7.4±0.52
N2	7.9±0.32	7.7±0.48	7.9±0.74	7.8±0.79	7.5±0.71	7.3±0.82	7.6±0.52	7.4±0.70	7.3±0.82	7.2±0.92	7.6±0.52	7.5±0.53
F2	7.9±0.32	7.7±0.48	7.9±0.74	7.8±0.63	7.5±0.53	7.3±0.67	7.6±0.52	7.4±0.70	7.3±0.67	7.2±0.79	7.6±0.52	7.5±0.53
N3	7.7±0.48	7.6±0.52	7.9±0.57	7.8±0.63	7.2±0.42	7.0±0.67	7.3±0.67	7.0±0.82	7.8±0.42	7.7±0.48	7.6±0.52	7.4±0.70
F3	7.7±0.48	7.6±0.52	7.9±0.57	7.8±0.63	7.2±0.63	7.0±0.82	7.3±0.67	7.0±0.82	7.8±0.42	7.7±0.48	7.6±0.52	7.4±0.52
CD	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.530	0.631	0.589	0.629	N.S.	N.S.
SE (d)	0.207	0.258	0.269	0.306	0.268	0.328	0.264	0.314	0.293	0.313	0.281	0.249
SE (m)	0.147	0.183	0.191	0.216	0.190	0.232	0.187	0.222	0.207	0.221	0.199	0.176
CV	5.867	7.498	7.691	8.872	7.992	10.131	7.696	9.442	8.938	9.802	8.210	7.465
	Statistics of mean scores between 0^{th} day and 60^{th} day											
Mean	7.9	7.7	7.83	7.7	7.5	7.23	7.67	7.43	7.33	7.13	7.65	7.45
Variance	0.036	0.012	0.015	0.028	0.072	0.035	0.131	0.163	0.163	0.291	0.007	0.003
t Stat	5.4772		6.3246		6.3246		11.0680		3.1623		5.4772	
P	0.0014		0.0007		0.0007		0.0001		0.0125		0.0014	

***N1=** Normal rice vermicelli -100:0 (Rice: Sorghum)
F1=Flood affected rice vermicelli -100:0 (Rice: Sorghum)
N2=Normal rice vermicelli -75:25 (Rice: Sorghum)
F2=Flood affected rice vermicelli -75:25 (Rice: Sorghum)
N3=Normal rice vermicelli -50:50 (Rice: Sorghum)
F3=Flood affected rice vermicelli -50:50 (Rice: Sorghum)

The mean score for texture was maximum for N3 and F3 (7.7) and minimum for N1 and F1 (6.5) for the kheerafter storage.The mean score for overall quality was maximum for N1 and F1 (7.8) and 7.7 respectively and minimum for N3, F2 and F3 (7.6) for the kheer before storage. The mean score for overall quality was maximum for N1, N2 and F2 (7.5) and minimum for N3, F1 and F3 (7.4) for the kheer after storage. Statistically significant difference was observed in the mean scores for the sensory properties for kheer such as taste and texture at P< 0.05 level between the normal rice and flood affected rice vermicelli kheer and also in all the three variations studied before and after storage for a period of 60 days. However, there was no significant difference in other sensory parameters such as colour, appearance, flavor and overall quality of the kheer between the control and experimental samples as well as in all the three formulations prepared with both normal and flood affected rice before and after storage. Statistically significant difference was not observed in the mean sensory scores for all the attributes i.e. colour, appearance, flavor, taste, texture and overall quality before and after storage. Therefore, it can be concluded that the value added product i.e. kheer prepared with both normal and flood affected rice could be stored for a period of 60 days without deteriorative changes in the sensory properties.

Summary and Conclusions

Value added product of convenience and commercial importance has vermicelli was developed and tested for quality, sensory properties and shelf life (60 days). The significant results of the study are summarized here under:

- Statistically significant difference at P<0.05 in L* a* b* values was observed between the rice vermicelli samples. The lightness (L*) value of control samples showed more towards whiteness (100) compared to experimental samples. The a* value of experimental samples showed more towards redness (+a* value) compared to control samples. The b* value for all the samples was towards yellowness (+b* value). Statistically significant difference was observed in the mean scores for the sensory properties for kheer such as taste and texture at P< 0.05 level between the vermicelli prepared with normal and flood affected rice and also in all the three variations studied before and after storage for a period of 60 days. There was no significant difference in other sensory parameters such as colour, appearance, flavor and overall quality of the kheer with in the treatments, between the treatments and between the storage period for 60 days. The value added product i.e. kheer prepared with both normal and flood affected rice could be stored for a period of 60 days without deteriorative changes in the sensory properties. These findings could bring added value to the use of rice in formulations, as well as additional appeal to the health-conscious consumer. Leading to new openings for food makers that include rice vermicelli, rice milk and rice derivatives, such as rice flour and rice starch, in their products. Further extensive research is needed for the utilization of paddy for the production of more feasible and convenient products in order to minimize the losses in flood affected paddy. The study is highly important in the present day context of rice farmers facing problems of marketing flood affected rice which are not preferred for consumption as normal rice due to their poor grain quality characteristics. The present study describes the utilization of not only flood affected rice but also normal rice into various value added products such as vermicelli and rice milk. Popularization of these value added products facilitate good earnings to the farm families by minimizing distress sale besides creating new ways of rice consumption pattern.

Future research

Listed below are the major recommendations

- Formation of farmer organization/co-operatives/companies for initiation of value added process to improve and profits from rice farming.
- Adopt improved pre and post-harvest technologies to prevent the quantitative and qualitative losses that occurred during flooding.

- Strengthening flooded paddy, rice and food based research work for uninterrupted flow of technology that would significantly improve the quality of rice and also to satisfy the world food needs.

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