Cooking and Sensory Quality Characteristics of Flood Affected Rice in Comparison With Normal Rice

ABSTRACT

Rice is a major component of the agricultural sector in particular and the overall economy in general. Over 20% of rice fields in India are prone to floods every year. The produce obtained from such fields are often sold at low price causing economical loss to the farmers. This study investigated....Therefore, the present study was conducted to know the cooking and sensory quality characteristics of flood affected rice in comparison with normal rice. Statistically significant difference ($P<0.05$) in cooking time (N: 20 min and F: 14 min), cooking weight (N: 351.88 g and F: 360.97 g), cooking loss (N: 0.67 g and F: 1.9 g) and elongation ratio (N: 1.98 mm and F: 3.04 mm) was observed between the flood affected rice and normal rice. The mean sensory scores of rice revealed statistically significant difference ($P <0.05$) between the normal rice and flood affected rice (N: 4.7 and F: 3.9 respectively). No significant difference was observed in the mean scores for appearance (N: 4.7 and F: 4.3), flavour (N: 4.3 and F: 4.1), taste (N: 4.2 and F: 4.1), texture (N: 4.6 and F: 4.4) and overall quality (N: 4.4 and F: 4.1) between the samples. Therefore, 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.

The abstract is not well structured.

(The opening statement, brief introduction on ho samples were collected, handled, processed, analyzed, before the results in ranges)

Introduction

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 (ref). Rice grown especially in Asia, Africa, and Latin America supplies the vital calories and energy required for everyday tasks. In many areas, rice is an essential part of the social and cultural fabric in addition to being a staple diet.

But paddy fields are frequently prone to floods especially in coastal areas (Abdelsalam *et al.,* 2025).

Nearly a billion people are thought to reside in flood-prone areas, and because of unpredictable precipitation events and fast population increase, this figure is expected to quadruple by 2050 (UNU, 2018). Around 6.8

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million human lives have been lost due to floods and according to a study, two billion people were affected between 1995 and 2015 (Wahlstrom and Guha-Sapir, 2015). The frequency and intensity of flooding are rising alarmingly in the context of climate change, with Asia experiencing a remarkable fourfold rise in this regard between 1982 and 2006 (Singha *et al.,* 2020). Understanding the geographic scope and occurrence of floods helps government and disaster relief organizations provide prompt and effective assistance to people affected by floods. By identifying regions that flood frequently, the devastating effects of floods on agriculture and people can be lessened (Doocy *et al.,* 2013). The world's second-largest producer of rice is India. However, due to climate-induced natural hazards including floods, droughts, and cyclones that hinder local rice production, food security remains a worry for this country (Maclean et al., 2013). Flooding is the most frequent of these calamities and has a significant impact on rice output (ref). Therefore, identifying places that flood often and rice paddies affected by flooding is crucial for preventing floods, minimizing property damage, and guaranteeing India's food security. India's low-lying regions frequently experience flooding.

Paddy loss due to flooding in India alone amounts to an estimated 2 million tons per year enough to feed 15 million people. This affects the market value of rice which depends upon cooking and processing quality (ref).. These qualities can be measured in terms of optimum cooking time, water uptake ratio, grain elongation, residual solid loss**,** swelling index, etc. (Ekka *et al.,* 2016). Also, the moistened paddy due to floods undergoes deteriorative changes such as low head rice yield (HRY), poor physico-chemical, nutritional, sensory and organoleptic quality changes.

One crucial factor in determining customer approval of rice is its eating quality (Moafizad et al. 1978). There are thousands of rice farmers in India, and many different types of rice have been developed, but little is known about their qualities for human consumption (Bhattacharya et al. 1980). Hence this research work was taken to compare the qualitative changes in flood affected rice and compared to that of normal rice.

Material And Methods

The field investigation was carried out at Post Graduate and Research Centre (PGRC), Professor Jayashanker Telangana Agricultural University (PJTAU), Rajendranagar, Hyderabad. For this purpose, both normal paddy and flood affected paddy samples of same variety were procured from Raavulapaalem in West Godavari district of Andhra Pradesh. The various ingredients used for preparation of the products and containers and packaging materials were obtained from local market. Organoleptic properties such as cooking time, cooking weight, and cooking loss were determined by following AACC, (1995) method.

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To evaluate these properties, about five grams of rice sample was taken and placed in 250 ml of boiling water in a 500 ml beaker and is subjected to cooking (Fig 1). Now a sample of the cooked rice is taken and pressed between the glass plates. The time required for the opaque part to be gelatinized was considered as cooking time. The cooking weight (% dry basis) as a measure of the degree of hydration of a 25 g dry rice sample cooked in 300 ml boiling water at optimal cooking time was recorded and the cooking loss (% dry basis), weight of total solids loss during cooking, was measured by evaporating the rice cooking water to dryness in a 100±1° C oven for 20 hr.

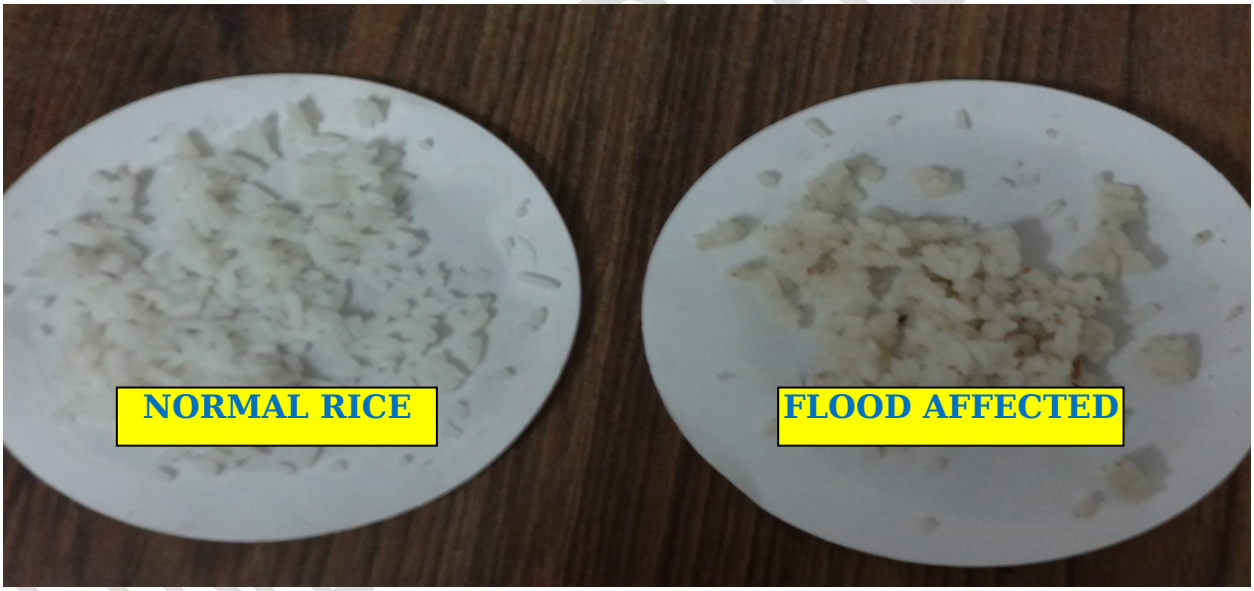


Fig 1. Cooked Rice Samples

To evaluate sensory properties, two samples of rice were taken and score was given for each sample for the attributes like colour, flavour, appearance, taste and texture using the 5 point Hedonic scale. Using this scale, samples were analyzed for desirable and undesirable characteristics (Table 1). Panelists' preferences are used to evaluate the quality attributes of products through sensory testing. On a hedonic scale, the panelists' expressed preference is represented by the greatest score, while their

distaste of sampling is indicated by the lowest score. Determining the impact of treatment on product quality attributes is the aim of quality testing. There are five options for evaluating quality attributes. In order to counteract the taste on the tongue, panelists were given water throughout each evaluation session. There are fifteen grams of samples per formula. Before the evaluation was conducted, the respondent completed the informed consent form to serve on the panel. All the results were statistically analysed to test the significance of the results using percentages, means, standard deviations and analysis of variance (ANOVA) technique. (Snedecor and Cochran 1983).

Table 1: Quality Description for Cooked Rice

Attributes	**Desirable characteristics** **Undesirable characteristics**
Colour	
Appearance	

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Attributes	**Desirable characteristics**	**Undesirable characteristics**
Colour	White (translucent)/off white/ cream	Red/brown/ creamish yellow
Appearance	Separated grains which retains its shape	Dull, lumpy, mashed, uncooked
Flavor	Pleasant, typical grain, well cooked flavor	Off flavor
Taste	Well cooked, typical rice bland taste/ sweet taste	Starchy taste
Texture	Well separated grains/ Tender/Soft	Sticky /Pasty/Hard/Lumpy/Tough Starchy

Results and Discussion

Organoleptic properties of rice

The organoleptic properties of normal rice and flood affected rice are given in table 2 and fig 2. The cooking time was found to be higher for normal rice (20 min) as compared to flood affected rice (14 min). In

contrast, cooking weight and cooking loss were higher in flood affected rice (360.97 g, 1.9 g) as compared to normal rice (351.88 g, 0.67 g respectively) (REF). Statistically significant difference ($P<0.05$) in all the three attributes (cooking time, cooking weight & cooking loss) was observed between the samples. Similar findings were observed by Rachel *et al*. (2013) who reported that flood rice variety has taken minimum cooking time of 10 minutes followed by white rice (12.67 min.) as it is possible to reduce the cooking time of rice with presoaking. Sowbhagya and Ali (1991) also observed reduction of cooking time when rice was presoaked. Also, presoaking leads to energy saving and is suggested as a vital step in the manufacture of dried rice from pre-gelatinized starch (Yano *et al*. 1988).

Statistically significant difference at $P<0.05$ in elongation ratio was observed between the two samples. The elongation ratio among the samples was found to be higher for flood affected rice (3.04 mm) when compared to normal rice (1.98 mm). The less elongation of normal rice during soaking is due to high gelatinization temperature which elongates less during cooking than low and intermediate gelatinizing rice. Shubhneet *et al*. (2011) also conducted similar studies on evaluation of grain quality of some basmati and non-basmati rice cultivars and found that the elongation ratio was more than 1.9 in all the basmati varieties and less in non-basmati varieties due to difference in gelatinization.

Table 2: Organoleptic properties of normal and flood affected rice.

Sample	Cooking time (min)	Cooking weight (g)	Cooking loss (g)	Elongation ratio (mm)
Normal rice	20±1	351.88±2.99	0.67±0.06	1.98±0.13
Flood affected rice	14±1	360.97±2.52	1.9±0.1	3.04±0.16
CD	2.328	6.426	0.190	0.341
SE (d)	0.816	2.254	0.067	0.120
SE (m)	0.577	1.594	0.047	0.085
CV	5.882	0.775	6.362	5.840

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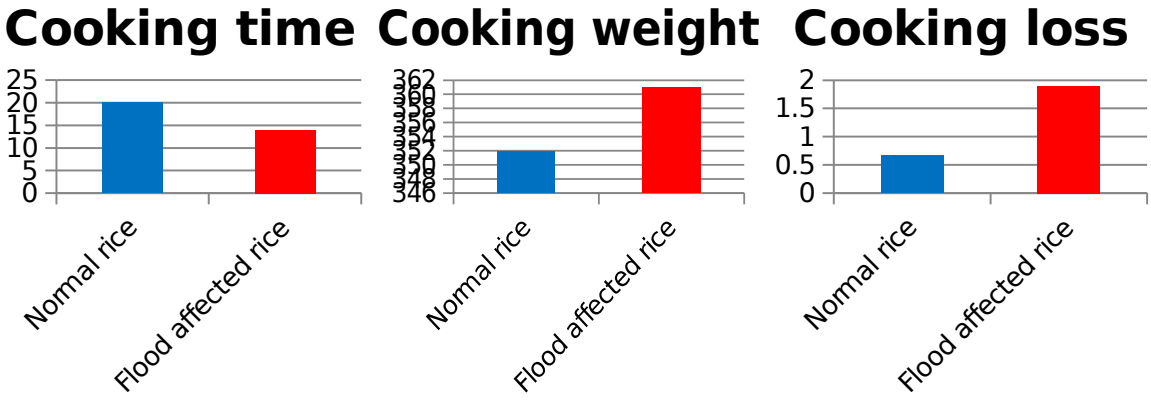


Fig 2. Organoleptic Properties of Rice Samples.

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Sensory properties of rice

The sensory properties of normal rice and flood affected rice are given in table 3 and fig 3. The mean sensory scores for all the attributes after cooking was found to be non significant. However, these values were slightly higher for normal rice (colour 4.7, appearance 4.7, flavor 4.3, taste 4.2, texture 4.6 & overall quality 4.4) as compared to flood affected rice (colour 3.9, appearance 4.3, flavor 4.1, taste 4.1, texture 4.4 & overall quality 4.1). Statistically significant difference at $P<0.05$ in colour scores was observed between the samples with normal rice showing colour variance in comparison to flood affected rice.

The primary factor influencing a consumer's initial preference for a product is its color. If a product's color deviates from what it should be, consumers will not be engaged and will not give other quality qualities a positive evaluation (Winarno, 2008; Andarwulan *et al.,* 2011). According to Table 2, the average panelist evaluation of color indicators falls between 3.9 and 4.7, indicating that panelists' opinions range from somewhat disapproving to favoring. The kind of rice has a significant impact on the color indication ($p <0.05$). Adi *et al*. (2020) also registered similar findings

and suggested that white rice with conventional cooking methods was more acceptable to panelist with the characteristics of bright colors, smell, neutral taste, and delicate texture. These findings are also in line with Danbaba *et al.* (2011).

Table 3: Mean sensory scores of normal rice and flood affected rice

Sample	Colour	Appearance	Flavour	Taste	Texture	Overall quality
Normal rice	4.7±0.48	4.7±0.48	4.3±0.67	4.2±0.63	4.6±0.52	4.4±0.52
Flood affected rice	3.9±0.74	4.3±0.67	4.1±0.57	4.1±0.57	4.4±0.52	4.1±0.32
CD	0.590	N.S.	N.S.	N.S.	N.S.	N.S.
SE (d)	0.279	0.262	0.279	0.269	0.231	0.191
SE (m)	0.197	0.186	0.197	0.190	0.163	0.135
CV	14.503	13.042	14.848	14.480	11.476	10.075

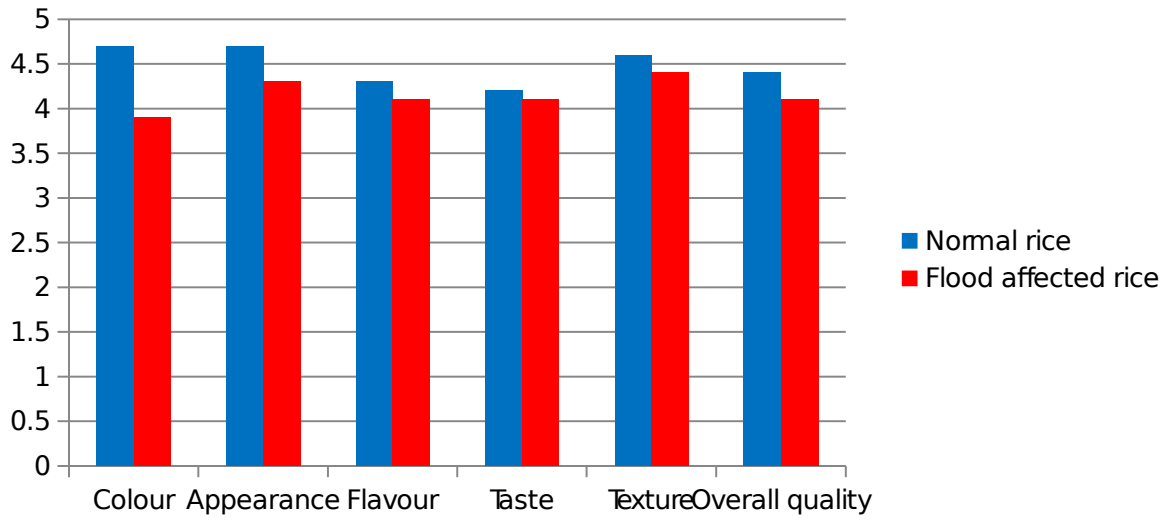


Fig 3. Mean sensory scores of normal rice in comparison with flood affected rice

CONCLUSIONS

Unexpected floods and excessive rains in rice fields that have reached maturity lead farmers to suffer considerable losses and directly or indirectly

put a sizable percentage of the population at risk of starvation. The purpose of the current study was to compare the quality attributes of rice impacted by flooding to those of regular rice. All three characteristics i.e., cooking time, cooking weight, and cooking loss showed statistically significant differences between the samples. When comparing flood-affected rice to regular rice, the elongation ratio was higher for the former. When cooked, normal rice had higher mean sensory scores for every attribute than rice affected by flooding. Such rice can be used because the flood does not affects any sensory qualities except color, this rice can be used to create value-added products where color is not a top priority. This will help farmers avoid suffering significant losses from floods.

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