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Effect of soaking time and roasting temperature on proximate composition and sensory attributes of flaked rice

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Abstract
Flaked rice is one of the popular snacks in India. Among the four rice varieties, best flaking was obtained by the JR-81 and KRANTI varieties. It was found that moisture content, fat content, protein content were decreased and ash content was increased after processing of flaked rice. The best organoleptic score viz. 8.02 was observed in T5 of KRANTI and least score viz. 7.17 observed in T6 of JR-81 variety. Minimum protein content was observed in T4 of JR-81(5.14) and T9 of IR-64 (5.42) respectively and maximum KRANTI T2 7.65 which could be the reason for better flaking quality. Higher flaking characteristics were observed for each variety at 150-160 °C roasting temperature. Higher flaking yield was found in JR-81 and KRANTI varieties. The amylose content of KRANTI had similar characteristics as JR-81 and was rated high in sensory acceptability. The data were analyzed by skeleton of ANOVA for complete randomized design (CRD).

Keywords: roasting temperature, proximate composition, sensory attributes

Introduction

Rice (*Oryza sativa* L.) is one of the leading food crops of the world, the staple food of over half the world's population. India contributed to about 19 % of the world production of paddy from 24 % of the total paddy cultivated area (FAO 2012) [6]. It is an important source of energy, vitamins, mineral elements, and rare amino acids, and rich in carbohydrates, contributes with about 60 to 70% of the energy needs, not only as a staple food but also as convenience food such as breakfast cereals, multigrain flakes, puffed, popped and extruded products; its pre-gelatinized and puffed flour has use as ingredients for cakes, desserts and sweets, formulated baby foods, soups, stews, crackers, noodles, puddings, bread, fermented foods like idli, dosai, dhokla, rice vinegar, wine etc.. Moreover, rice starch has been used as thickener and is the raw material for the production of rice maltodextrins and syrups. Rice starches also have been found to be useful as a fat replacer, used particularly in ice cream, cheesecake, sour cream, mayonnaise, salad dressings, spreads and cookies (FAO 2012) [6].

The rice production, processing and marketing constitute the biggest industry in the country. It has been estimated that about 10 percent of total rice production is utilized for production of flaked rice, expanded rice and popped rice (Sulochana *et al*, 2007) [10]. Rice flakes is also locally known by many names like Aval (Tamil and Malayalam), avalakki (Kannada), atukulu (Telugu), Poha (Hindi), pauaa/paunva (Gujarati), poya (Rajasthani), chuda (Odisha) and , chira (Bengali and Assamese), chiura (Maithili, Nepali, Bhojpuri and Chhattisgarhi), baji (Newari), pohe (Marathi), phovu (Konkani), chivda and beaten rice. Flaked rice is consumed as raw or with milk.

Rice flakes or Poha is an important breakfast in semi-urban and rural areas and middle-class families of urban India. Spicy or sweet preparations made from it are not only easy to make but they can be made at a short notice as well. Therefore, it is extensively used all over the country round the year. Apart from households, its spicy preparations are also sold in restaurants, roadside dhabas or eateries, and canteens etc. In states, where it is consumed as breakfast, there is more production and larger industries exist. Flaked Rice (Poha) industries are located in different states of the country (Sulochana *et al*, 2007) [10]. In this regard, it provides a good scope for farmers to produce flaked rice and for new entrepreneurs to start Poha mill industries in Madhya Pradesh.

KRANTI and Mahamaya are prominent varieties that are extensively grown indifferent parts of Madhya Pradesh. These varieties are quite old and their yield is also declining due to several reasons. Therefore, farmers demand new alternative varieties for Flaked rice (Poha) industry.

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Materials and Methods
Experimental Site:- The experiment was conducted in the Grain Science and Crop Quality Laboratory of Department of Food Science and Technology, JNKVV Jabalpur (MP) and M/S Shree Sharda Industries Waraseoni, Balaghat (MP).

Materials
The grains of 4 varieties namely KRANTI, JR-81, MTU-1010 and IR-64 were used in the investigation 5 kg each. The sample materials were properly cleaned, graded and then properly packed in cloth bags and stored at ambient condition for further use in experiments.

Method
Chemical composition of paddy varieties- Starch is composed of two components, namely amylose and amylopectin. Amylose is a linear or non-branched polymer of glucose. The glucose units are joined by α-1-4 glucosides linkages. Amylose exists in coiled form and each coil contains six glucose residues (Sadasivam and Manickam, 2005) [9].

Effect of soaking time and roasting temperature on Sensory quality attributes score of Flaked Rice- A semi trained panel of 10 members was given samples of prepared product of flaked rice (Poha) to evaluate the following sensory quality attributes viz., colour, flavor, taste, texture and over all acceptability score. A nine point hedonic rating scale score card was used as described in AACC (2000) [1].

Statistical Analysis- The skeleton of ANOVA for complete randomized design (CRD) is presented in table given below: (Cyprien and Kumar, 2012) [4]

Results and Discussion
Chemical composition and Functional properties of paddy varieties- The results of starch, amylose and amylopectin content in different varieties of paddy are presented in (Table 3.0) depicted through among four varieties under investigation starch, amylose and amylopectin content varies from 71.97 to 76.61, 20.13 to 25.06 and 74.93 -79.86 percent. The findings reveal that the cultivars belong to group of high starch and high amylopectin content. The findings of investigation are supported with the reported values of Bhattacharya *et al.* (2004) [3] and Joshi *et al.* (2014) [7].

Effect of soaking time and roasting temperature on proximate composition of flaked rice- Table 2.0, indicates that the results effect of soaking time and temperature on proximate composition of flaked rice. The proximate composition parameters viz, the moisture content varies from 6.36 to 6.90, 6.56 to 7.54, 6.49 to 7.7 and 6.73 to 7.66 respectively. The protein content varies from 5.45 to 6.59, 5.14 to 6.78, 5.45 to 6.48 and 5.42 to 6.45 respectively. The fat content varies from 1.12 to 1.25, 0.73 to 1.20, 0.82 to 1.15 and 1.02 to 1.09 respectively. The crude fiber ranges from 1.89 to 2.71, 1.78 to 2.73, 1.97 to 2.31 and 1.83 to 2.05 respectively. The ash content varies from 1.11 to 1.80, 0.82 to 1.69, 0.96-1.45 and 1.03-1.99 respectively. The above data's revealed that the soaking time and roasting temperature do not play a vital role to influence the proximate composition of the all four varieties during flaking of rice. The findings of present investigation are in conformity with the reported results of Daomukda *et al.* (2011) [5] and Joshi *et al.* (2014) [7].

Effect of Soaking time and roasting temperature on Starch, amylose and Amylopectin of Flaked Rice- Table 3.0, comprises the results effect of soaking time and temperature on starch, amylose and amylopectin of four different varieties of paddy viz. KRANTI, JR-81, MTU-1010 and IR-64 of paddy. Starch varies from 72.43 to 76.18, 68.45 to 75.62, 70.81 to 74.40 and 70.95 to 73.36 percent respectively. The amylose content ranges from 22.36 to 26.44, 19.87 to 24.64, 19.91 to 25.46 and 22.24 to 26.16 percent respectively. And amylopectin content from 73.56 to 77.63, 75.36 to 80.13, 74.54 to 80.09 and 73.83 to 77.76 percent respectively. The findings of present investigation are in conformity with the reported results of Bhattacharya *et al.* (2004) [3] and Oko *et al.* (2012) [8].

Effect of soaking time and roasting temperature on Sensory quality attributes score of Flaked Rice- Table 4.0, presents the Effect of soaking time and roasting temperature on Sensory quality attributes score of Flaked Rice of four different varieties viz. KRANTI, JR-81, MTU-1010 and IR-64 of paddy. Higher in KRANTI paddy variety for thick sized flaked rice as compare to other variety hence the texture of flaked rice of KRANTI was best. The higher score for all attributes were given to KRANTI (7.11 to 8.02) (the T_5 treatment got the best overall acceptability among all 9 treatments) followed by JR-81 (7.17 to 7.88), (the T_5 treatment got the best overall acceptability among all 9 treatments), MTU-1010 (7.30 to 7.75) (the T_4 treatment got the best overall acceptability among all 9 treatments) and IR-64 (7.21 to 7.81) (Treatment T_3 got the best overall acceptability among all 9 treatments) respectively. The findings of present investigation are in conformity with the reported results of Anitha and Rajalakshmi (2012) [2].

Table 1: Combinations, to study effect of soaking time and roasting temperature for production on flaked rice.

S. No.	Treatments	Combination	Treatment Description
1.	T1	S1T1	12 hr Soaking time and 140-150 °C
2.	T2	S1T2	12 hr Soaking time and 150-160 °C
3.	T3	S1T3	12 hr Soaking time and 160-170 °C
4.	T4	S2T1	16 hr Soaking time and 140-150 °C
5.	T5	S2T2	16 hr Soaking time and 150-160 °C
6.	T6	S2T3	16 hr Soaking time and 160-170 °C
7.	T7	S3T1	24 hr Soaking time and 140-150 °C
8.	T8	S3T2	24 hr Soaking time and 150-160 °C
9.	T9	S3T3	24 hr Soaking time and 160-170 °C

Table 2: Effect of different soaking time and roasting temperature on proximate composition of flaked rice

S. No.	Varieties	Treatment	Moisture (%)	Protein (%)	Fat (%)	Fibre (%)	Ash (%)
1.	Kranti	T1	6.90	6.59	1.19	2.71	1.44
		T2	6.75	7.65	1.23	1.98	1.44
		T3	6.85	7.15	1.24	2.15	1.68
		T4	6.45	6.01	1.22	2.00	1.76
		T5	6.36	6.39	1.25	2.16	1.54
		T6	6.46	5.45	1.16	2.00	1.41
		T7	6.48	5.76	1.24	2.11	1.80
		T8	6.36	6.29	1.12	1.89	1.11
		T9	6.44	6.51	1.23	1.92	1.39
		C.D.@5%	0.09	0.51	0.07	0.09	0.26
		SE(m)±	0.03	0.17	0.02	0.03	0.09
2.	JR-81	T1	7.16	6.60	0.84	2.19	1.69
		T2	6.77	6.33	0.87	2.73	1.04
		T3	7.52	5.96	0.73	2.30	1.64
		T4	7.54	5.14	1.02	1.78	1.12
		T5	6.61	6.89	0.99	2.63	1.14
		T6	6.83	6.78	1.16	2.48	0.82
		T7	6.69	6.60	0.95	1.96	1.58
		T8	6.56	6.46	1.15	2.12	1.40
		T9	6.59	6.11	1.20	2.49	1.58
		C.D.@5%	0.29	0.58	0.18	0.33	0.50
		SE(m)±	0.10	0.19	0.04	0.16	0.17
3.	MTU-1010	T1	7.67	5.45	1.03	2.07	1.23
		T2	7.44	6.48	1.08	2.02	1.35
		T3	7.60	5.68	1.03	2.10	1.45
		T4	6.72	5.59	1.08	2.31	1.18
		T5	6.65	6.31	1.08	2.14	1.35
		T6	7.43	6.19	0.92	2.21	1.35
		T7	6.50	5.52	1.15	2.09	0.96
		T8	6.49	5.78	0.82	1.98	1.37
		T9	7.47	6.06	1.11	1.97	1.20
		C.D@5%.	0.53	0.67	0.14	0.56	0.25
		SE(m)±	0.18	0.22	0.05	0.19	0.08
4.	IR-64	T1	7.13	5.53	1.05	1.87	1.42
		T2	7.66	6.12	1.08	2.05	1.90
		T3	7.19	6.22	1.04	1.83	1.03
		T4	6.76	6.45	1.09	1.86	1.83
		T5	6.61	5.93	1.03	1.85	1.03
		T6	6.59	6.29	1.04	1.96	1.99
		T7	6.73	6.40	1.02	1.92	1.66
		T8	6.74	6.13	1.09	1.96	1.14
		T9	6.91	5.42	1.03	2.02	1.90
		C.D.@5%	0.58	0.15	0.14	0.05	0.15
		SE(m)±	0.19	0.05	0.05	0.02	0.05

Table 3: Effect of different soaking time and roasting temperature on Starch, Amylose and Amylopectin content of flaked rice

S. No.	Varieties	Treatment	Starch (%)	Amylose (%)	Amylopectin (%)
1.	KRANTI	T1	75.67	24.79	75.20
		T2	76.18	26.44	73.56
		T3	76.06	25.05	74.95
		T4	75.49	26.02	73.98
		T5	76.11	25.66	74.33
		T6	75.92	24.24	75.75
		T7	72.68	22.36	77.63
		T8	73.43	24.12	75.87
		T9	74.07	25.13	74.87
		C.D.@5%	N/A	3.09	3.09
		SE(m)±	1.35	1.03	1.03
2.	JR-81	T1	75.62	23.51	76.49
		T2	74.44	23.86	76.14
		T3	73.26	24.06	75.94
		T4	72.43	24.64	75.36
		T5	69.09	21.76	78.24
		T6	68.45	19.87	80.13
		T7	69.48	22.24	77.76
		T8	71.91	23.29	76.71
		T9	66.93	23.95	76.05
		C.D.@5%	5.25	3.01	1.59
		SE(m)±	1.76	1.00	0.53

S. No.	Varieties	Treatment			
3.	MTU-1010	T1	70.81	22.66	77.34
		T2	73.92	23.76	76.24
		T3	74.40	19.91	80.09
		T4	72.34	25.46	74.54
		T5	72.54	22.50	77.50
		T6	74.04	24.61	75.39
		T7	73.40	23.50	76.50
		T8	70.95	23.36	76.64
		T9	73.77	23.39	76.61
		C.D.@5%	1.94	3.28	2.42
		SE(m)±	0.63	1.09	0.80
4.	IR-64	T1	71.54	25.91	74.09
		T2	72.22	24.24	75.75
		T3	73.36	24.21	75.78
		T4	70.95	25.21	74.79
		T5	73.25	22.24	77.76
		T6	72.30	26.16	73.83
		T7	72.05	22.59	77.40
		T8	73.24	23.65	76.34
		T9	73.03	22.98	77.01
		C.D.@5%	N/A	2.02	2.02
		SE(m)±	0.94	0.68	0.67

Table 4: Effect of different soaking time and roasting temperature on Sensory quality attributes score of Flaked Rice

S. No.	Varieties	Treatment	Colour	Flavor	Taste	Texture	Overall Acceptability
1.	Kranti	T1	7.58	7.5	7.02	7.34	7.36
		T2	7.57	7.56	7.45	7.6	7.54
		T3	7.63	8.26	7.43	7.21	7.63
		T4	7.53	7.63	7.11	7.34	7.4
		T5	7.82	7.99	7.91	8.37	8.02
		T6	6.79	7.27	7.13	7.28	7.11
		T7	7.5	7.37	7.31	7.27	7.36
		T8	7.26	7.43	7.97	7.38	7.51
		T9	7.41	7.42	7.38	7.31	7.38
		C.D.@5%	0.80	0.54	0.49	0.74	0.35
		SE(m)±	0.27	0.18	0.16	0.24	0.10
2.	JR-81	T1	7.4	7.01	7.23	7.3	7.23
		T2	7.7	7.61	7.62	7.59	7.63
		T3	7.9	7.66	7.29	7.52	7.59
		T4	7.26	7.37	7.63	7.36	7.4
		T5	7.87	7.85	7.86	7.94	7.88
		T6	7.3	6.9	7.3	7.2	7.17
		T7	7.4	7.41	7.36	7.02	7.29
		T8	7.3	7.5	7.43	7.33	7.39
		T9	7.8	7.36	7.28	7.44	7.47
		C.D.@5%	0.79	0.80	0.54	0.63	0.27
		SE(m)±	0.24	0.27	0.18	0.21	0.09
3.	MTU-1010	T1	7.14	7.54	6.97	7.56	7.3
		T2	7.14	7.28	6.97	8.17	7.39
		T3	7.28	8.063	7.66	7.65	7.66
		T4	7.79	7.71	7.64	7.87	7.75
		T5	7.22	7.71	8.13	7.27	7.58
		T6	7.45	7.41	7.7	7.43	7.49
		T7	7.85	7.35	7.62	7.37	7.54
		T8	7.25	7.38	7.49	7.2	7.33
		T9	7.56	7.42	7.84	7.58	7.6
		C.D.@5%	0.99	0.64	0.76	0.54	0.20
		SE(m)±	0.30	0.21	0.25	0.18	0.07
4.	IR-64	T1	7.47	6.71	7.06	7.6	7.21
		T2	7.22	7.08	7.76	7.56	7.40
		T3	7.81	7.74	7.80	7.91	7.81
		T4	7.21	7.53	7.26	7.24	7.31
		T5	7.61	7.57	7.36	7.54	7.52
		T6	7.29	7.77	7.23	7.26	7.38
		T7	7.26	7.81	7.06	6.99	7.28
		T8	7.88	7.29	7.30	7.68	7.53
		T9	7.44	7.61	7.50	7.44	7.49
		C.D.@5%	0.76	1.12	0.51	0.78	0.07
		SE(m)±	0.25	0.39	0.17	0.26	0.02

Conclusion

The physical properties of the paddy grain are very essential for designing and development of process machineries, feed hoppers, storage structure, material handling equipments and packaging purpose. For making good quality of flaked rice we need to good quality of paddy in all attributes like paddy should be large and bold size of grain. In this investigation the effect of soaking and roasting temperature was found to exhibit significant effect on proximate and sensory quality of flaked rice. The amylose content of KRANTI variety was similar as JR-81 and was rated high in sensory acceptability. Best sensory qualities attributes of flaked rice were observed in JR-81 variety followed by KRANTI, MTU-1010 and IR-64. Hence, KRANTI and JR-81 can be recommended for flaking purposes.

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