International Journal of Agriculture, Environment and Biotechnology
Citation: *IJAEB*: **16**(02): 101-104, June 2023
DOI: 10.30954/0974-1712.02.2023.7

ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

RESEARCH PAPER

Optimization of Process Parameters for Quick Cooking Rice

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Paper No. 1080 **Received:** 14-03-2023 **Revised:** 26-05-2023 **Accepted:** 07-06-2023

ABSTRACT

Instant rice is prepared by soaking followed by precooking and dehydration. Instant rice is rice that has been fully cooked and then dried down to below 12% moisture. Instant rice can then be recooked by the consumer in 2-5 min compared to 20 min required to cook the polished raw rice. The present research is carried out with soaking time (5, 10, 15 and 20 min) and soaking temperature (45, 50, 55, 60, 65 and 70° C), cooking methods (electric cooker and pressure cooker), cooking duration (4, 8 and 12 min) and drying methods (microwave oven and hot air oven) on the three varieties of long-grain, medium-grain and short grain rice. The cooking is being carried out by pressure cooker, electric for 3, 5 and 8 min and dried by microwave oven. The cooked rice is dried by hot air oven and by microwave in such a way as to leave the desired degree of porosity and fissuring in the final product. It was observed that the rice samples of short grain variety (BPT 5204) were cooked for 8 min by both electric cooker and pressure cooker and the reconstitution time varying from 7 min- 8 min were found to be having good texture compared to other samples. The long grain rice cooked for 8 min was comparatively of better quality when compared to the rice samples at other cooking durations of 4 and 12 min. But the reconstitution time of instant rice was observed to be more compared to other two varieties. The best quality of instant rice was found in Short grain rice (BPT 5204) followed by Medium grain rice (Sona Masuri 1768) and then Long Grain rice (NLR 145).

HIGHLIGHTS

- The best quality of the instant rice was found to be short grain rice (BPT 5204) followed by medium grain rice (Sona Masuri, 1768) and then long grain rice (NLR 145) which yielded after a reconstitution time of 7 to 8 min with quality consideration.
- It was observed that in NLR 145 variety treatment no. 2 (soaking time of 5 min, soaking temperature of 50 °C, cooked by electric cooker for 8min and dried by microwave oven) was observed to be better with 6.64% protein, 0.79% ash, 0.4% fat, 75% carbohydrates and Starch content 56%.
- BPT 5024 variety; soaking time of 5min, soaking temperature of 55 °C, cooked by electric cooker for 12 min and dried by microwave oven was observed to be 7.08 % protein, 0.5% ash, 0.6% fat, 75.9 % carbohydrates and 52 % Starch content.

Keywords: Instant rice, Quick cooking rice, reconstitution rice

Instant rice was prepared by soaking followed by precooking and dehydration. Instant rice is that rice which has been fully cooked and then dried to bring down the moisture content below 12% (d.b). The instant rice can be reconstituted in 2 to 5 min of cooking. A combination of soaking time, soaking temperature, cooking duration and drying methods on the three varieties (long-grain, medium-grain and short grain rice) were studies to obtain the optimum combination. The cooking is being carried out by pressure cooker, electric cooker and drying by hot air oven and microwave oven. Microwave

How to cite this article: Kumar, S. and Pande, P. (2023). Optimization of Process Parameters for Quick Cooking Rice. *Int. J. Ag. Env. Biotech.*, **16**(02): 101-104.

Source of Support: None; **Conflict of Interest:** None

heating can be used to achieve the degree of starch gelatinization essential for a rapidly rehydratable convenience product. The raw rice has been soaked in water until it reaches a moisture content of 35% (w.b), after soaking of rice, cooking is carried out to reach a moisture content of 68% (w.b) about equal to that of normal cooked rice. Therefore, the cooked rice is dried by microwave oven and hot air oven in such a way as to leave the desired degree of porosity and fissuring in the finished products.

Grosebeck (1990) described quick cooking rice as the dried precooked product prepared by cooking rice for obtaining moisture content from 55-75 % (w.b) by weight then drying the cooked rice at a temperature 140-185 ^{o}C by two stages, firstly under stationary conditions to a moisture content from 20-35 % (w.b) and secondly under agitated conditions to a moisture content of 3-15 % (w.b).

Weibye (1983) describes a continuous process for quick cooking rice. The gelatinized rice, without stirring, is then dried to a final moisture content of 10-14 % (w.b) with a resultant temperature for gelatinized rice between 79 ^{o}C-100 ^{o}C.

MATERIALS AND METHODS

Raw material: Long grain (NLR 145 Swarna Mukhai), medium grian (Masuri 1768) and short grain (Sona Masuri 1768) of local varieties of rice were selected and procured from the local market to conduct the experiments.

Experimental procedure

Soaking of Rice: Each variety of rice with sample size of 200 g was soaked in water bath for 4 levels of soaking time (5, 10, 15 and 20 min). The experiments were carried out at 6 levels of temperature (45, 50, 55, 60, 65 and 70^{o} C). After soaking for the required time interval, the sample was quickly withdrawn from water. The soaked rice sample were initially dried with blotting paper to remove the external moisture then moisture content was determined by hot air oven method.

Cooking of Rice by Electric Rice Cooker and Pressure Cooker: Experiments were conducted to standardize normal cooking procedure in Electrical Rice Cooker and pressure Cooker for the soaked samples. Cooking time 4, 8 and 12 min were taken. Sample size of 3g was taken, then superficially dried with, blotting paper to remove the external moisture and then immediately weighed to determine the moisture content. The cooked rice was then divided into two halves and dried in microwave oven and hot air oven.

Drying of Cooked Rice Samples by Microwave oven and Hot Air Oven: Cooked sample of 50 g, was spread evenly into a crust plate of the microwave oven. It was then put on the metal rack and then placed in oven. For Drying of cooked rice, microwave was operated in grill mode. Time was set and the sample was dried until the moisture content was reduced between 8-12 %. For drying in hot air oven, 50g of cooked sample, was taken and was spread evenly into a plate and was kept in the hot air oven. The oven was set at 95-100 ^{o}C. It takes about 35-55 min for drying of cooked rice to moisture content of 8-12 %.

Final Cooking Time/Reconstitution Time of Instant Rice: The reconstitution time or final cooking time of the instant rice samples prepared by different treatments and methods were noted by taking 15 g of sample and putting into the boiling water and the time for complete cooking was noted.

Quality Parameters of Instant Rice: Quality parameters like swelling ratio, reconstitution time and proximate analysis of protein, carbohydrates, fat, ash and starch contents in the prepared samples of instant rice were estimated.

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Swelling Ratio: It was determined by boiling a 10 g batch of dehydrated rice in 60 ml of distilled water. At different intervals the samples were withdrawn and the weights of the samples were determined after removing the surface moisture with blotted paper. The Swelling ratio (by weight) was expressed as the ratio of final to initial of the sample. The time required for complete rehydration was noted when

there was no further increase in the final weight of the sample during cooking.

Proximate Composition: The proximate analysis of protein, carbohydrates, fat, ash and starch contents in the prepared samples of instant rice were estimated by standardized AOAC methods.

RESULTS AND DISCUSSION

Effect of Soaking on Rice at Different Time – Temperature Levels : The moisture content of NLR- 145 (long grain rice) variety at 45°C for 5min Soaking was observed to be 26.05% (d.b) and was increased to 46.58% (d.b) at 70°C for 20 min soaking time. The moisture content of Sona Masuri 1768 (Medium grain rice) variety at 45°C for 5 min soaking was observed to be 28.01% (d.b) and was increased to 46.79% (d.b) at 70 °C for 20 min soaking time. The moisture content of BPT 5204 (Short grain rice) variety at 45°C for 5mins soaking was observed to be 25.70 % (d.b) and was increased to 45.63 % (d.b) at 70° C for min soaking time.

Drying of Cooked Rice: The rice samples which were cooked for 4 min, 8 min and 12 min and dried in Microwave Oven and Hot Air Oven. The rice samples cooked for 4 min and kept in microwave oven for drying, it was observed that after 9-12 min the rice samples were dried and the moisture content was found to be in the range of 10.5 to 12 % (d.b). Whereas the rice samples cooked for 8 min and kept in microwave oven for drying. It was observed that after 15-17 min the rice samples were dried and the moisture content was found in the range of 9 to 11.5 % (d.b). And the rice samples cooked for 12 min and kept in microwave oven for drying, it was observed that after 20-22 min the samples were dried and the moisture content was found to be in the range of 8 to 9.5 % (d.b)

Reconstitution Time / Final Cooking Time: The rice samples of long grain variety (NLR 145) were cooked for 8 min by both electric cooker and pressure cooker and the reconstitution time varying from 7 min – 8 min were found to be having good texture compared to other samples. Further it was also observed that the samples cooked by electric cooker for 8 min and dried by microwave oven, the reconstitution time was found to be 7 min to 8 min, better than the rice samples cooked by pressure cooker for the same duration. Similar observations were found to be true with the varieties of medium grain and short grain rice varieties.

Swelling Ratio: Swelling ration of the rice samples were determined by boiling a 10 g of dehydrated rice samples in 60 ml of distilled water. The swelling ratio was expressed as the ratio of final to initial weight of the sample. Swelling ration was observed to be between 3.0-3.9 with the highest swelling ratio of 3.9 for BPT 5204 variety was having soaking time 5min, at temperature of 55°c by Electric cooker and microwave drying for 8 minutes and least 3.0 for NLR145 variety was having soaking time 30s, soaking temperature 30°C, cooked by Auto clave, drying time 3 minutes by microwave oven.

Proximate Analysis: The experiments were conducted for the proximate Analysis of Protein Content, Ash Content, Fat Content, Carbohydrates Content and Starch Content. NLR145 variety was having soaking time 5 minutes, soaking temperature 50°C, cooked by Electric Cooker, and microwave drying for 8 minutes was observed to be better with 6.64% protein, 0.79% ash, 0.4% fat, 75% carbohydrates and Starch content 56%.

Table 1: Moisture content (db%) of Rice variety (NLR 145) soaked samples at different time - temperature levels

Soaking Time, min	Moisture content (db%) at different temperature levels					
	45 °C	50 °C	55 °C	60 °C	65 °C	70 °C
5	26.05	30.18	33.33	34.32	35.94	36.57
10	29.35	35.13	34.86	37.19	38.06	39.75
15	35.94	37.193	35.95	38.45	40.36	42.4
20	38.66	40.18	40.56	41.95	43.54	46.58

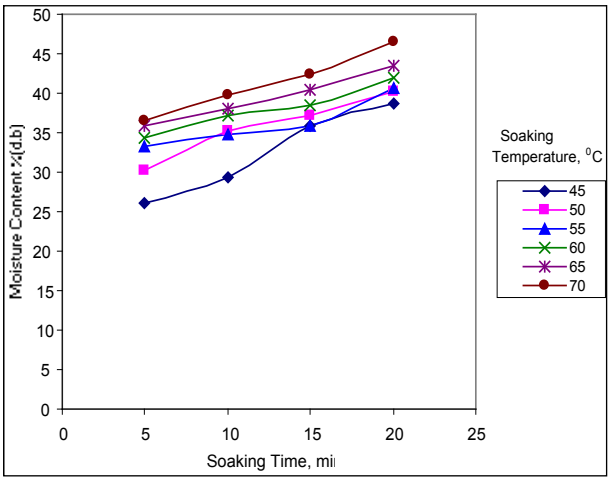

Fig. 1: Effect of Soaking Time on Moisture Content of NLR-145 Variety at different Soaking Temperatures

Table 2: Moisture content (db %) of Rice variety (Sona Masuri 1768) Soaked samples at different time-temperature levels

Soaking time, min	Moisture content (db%) at different temperature levels					
	45 ˚C	50 ˚C	55 ˚C	60 ˚C	65 ˚C	70 ˚C
5	28.01	29.49	33.13	33.52	33.33	38.24
10	29.68	35.33	34.92	35.53	38.67	40.40
15	34.52	37.82	37.61	39.09	40.41	43.54
20	37.61	39.96	41.28	41.28	42.86	46.79

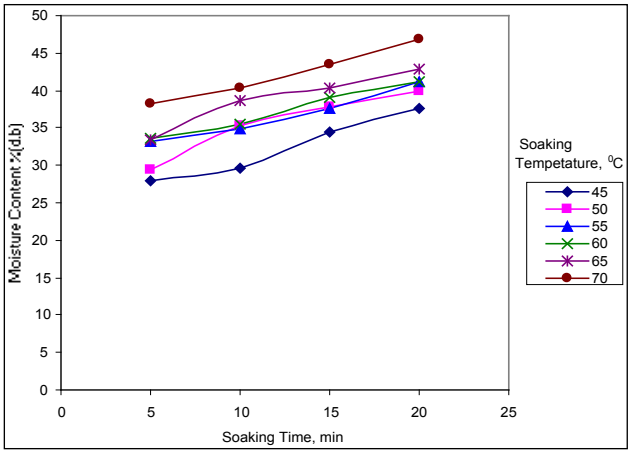

Fig. 2: Effect of Soaking Time on Moisture Content of Sona Masuri 1768 Variety at different Soaking Temperatures

Table 3: Moisture content (db%) of Rice (BPT-5204) soaked at different temperature levels

Soaking time, min	Moisture content (db%) at different temperature levels					
	45 ˚C	50 ˚C	55 ˚C	60 ˚C	65 ˚C	70 ˚C
5	25.70	29.12	31.19	33.72	35.13	36.56
10	29.44	34.72	33.33	36.15	37.19	38.03
15	35.95	37.40	35.53	38.67	39.96	43.31
20	37.61	39.331	40.4	41.72	43.31	45.63

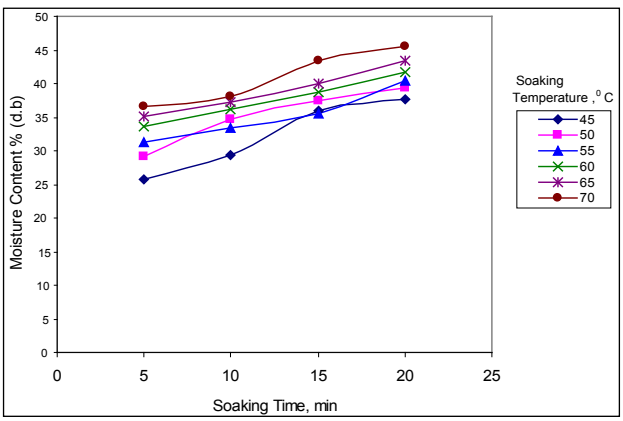

Fig. 3: Effect of Soaking Time on Moisture Content of BPT 5204 Variety at different Soaking Temperatures

CONCLUSION

It was observed that in all the varieties the water up take was more or less similar at the same soaking time and temperature but the instant rice and cooked instant rice varied depending on cooking duration, chemical treatment and drying methods. The best quality of the instant rice was found to be short grain rice (BPT 5204) followed by medium grain rice (Sona Masuri 1768) and then long grain rice (NLR 145) which yielded after a reconstitution time of 7 to 8 min with quality consideration.

It was observed that in NLR 145 variety treatment no. 2 (soaking time of 5 min, soaking temperature of 50 °C, cooked by electric cooker for 8min and dried by microwave oven) was observed to be better with 6.64% protein, 0.79% ash, 0.4% fat, 75% carbohydrates and Starch content 56%. It was observed that in Sona Masuri 1765 variety treatment No.6 (soaking time of 15 min, soaking temperature of 65 °C, cooked by electric cooker for 8 min and dried by microwave oven) was observed to be better with 6.64 % protein, 0.19 % ash, 0.5 % fat, 80 % carbohydrates and 58 % starch content it was observed that in BPT 5024 variety. BPT 5024 variety; soaking time of 5min, soaking temperature of 55 °C, cooked by electric cooker for 12 min and dried by microwave oven was observed to be 7.08 % protein, 0.5% ash, 0.6% fat, 75.9 % carbohydrates and 52 % Starch content.

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