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Quick Parboiling, Drying and Milling of Paddy

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Research Article

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Parboiling, Paddy, Milling, Head rice, Broken, Dehusking.

ABSTRACT

In India especially Southern-Eastern part of the India, traditional parboiling is still widely practiced among rice processors even though it results in inferior grain quality. The quick parboiling of AVAXI and 424 varieties was performed by steaming the sample in water bath and then sample was sun dried. In sun drying samples were reached 12 to 13% dry basis moisture content. Then these quick parboiled and sun dried samples were taken for milling operation. The milling results show that more head rice is obtained and less broken rice were found. This steam parboiling was found quicker technique than presently available time consuming process of par boiling.

INTRODUCTION

In India especially Southern-Eastern part of the India, traditional parboiling is still widely practiced among rice processors even though it results in inferior grain quality [1]. The hydrothermal treatment prior to paddy milling is called as parboiling of rice. Parboiling is the process of boiling of rough paddy in hot water (70°C) up to full soaking of paddy [2]. It this work an attempt has been made to do the parboiling quicker. The soaking and drying are the long time consuming process, both are major barrier in fast processing of paddy from parboiling to milling. The results for moisture content of initial sample, soaking time, moisture just after soaking, drying characteristics, milling, percent broken, percent total head are discussed in this research note. AVAXI and 424 are the two verities selected for this study. They are the leading paddy verities grown locally [2-5].

MATERIALS and METHODS

The AVAXI and 424 paddy varieties are the two varieties which were used for the experiment. Samples were first sieved and cleaned. Then sample were weighted and steamed and parboiled. Autoclave, steamer, digital weighing balance, drying trays and temperature indicator are required for this experiment [2-5,7,8].

SAMPLE PREPARATIONS

Paddy samples AVAXI and 424 were collected and processed for the test and the samples are represented in the **Figure 1**.

Process Flow for Paddy Processing- Parboiling, Drying and Milling

The adopted methodology of parboiling drying and milling is explained in **Figure 2** of this article. During this process samples were selected and weighted for the process, followed by which samples were kept in a cloth or sometimes it can be kept in

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perforated vessels too depending on the necessity. Autoclaving was done in the next stage of the process where temperature was maintained at 96ºC and pre-steaming was done for 15 minutes. The sample was taken out of the autoclave in the following step and further weighted following which preheated water was added at 90ºC where a ratio of 1:2.5 was maintained for paddy and water. Four hours of soaking was done for the paddy sample at 70ºC in a water bath. Later on, the soaked paddy was taken out and the remaining water was drained and the sample was maintained at 96ºC for another 15 minutes followed by steaming.

Figure 1. Paddy sample taken for parboiling.

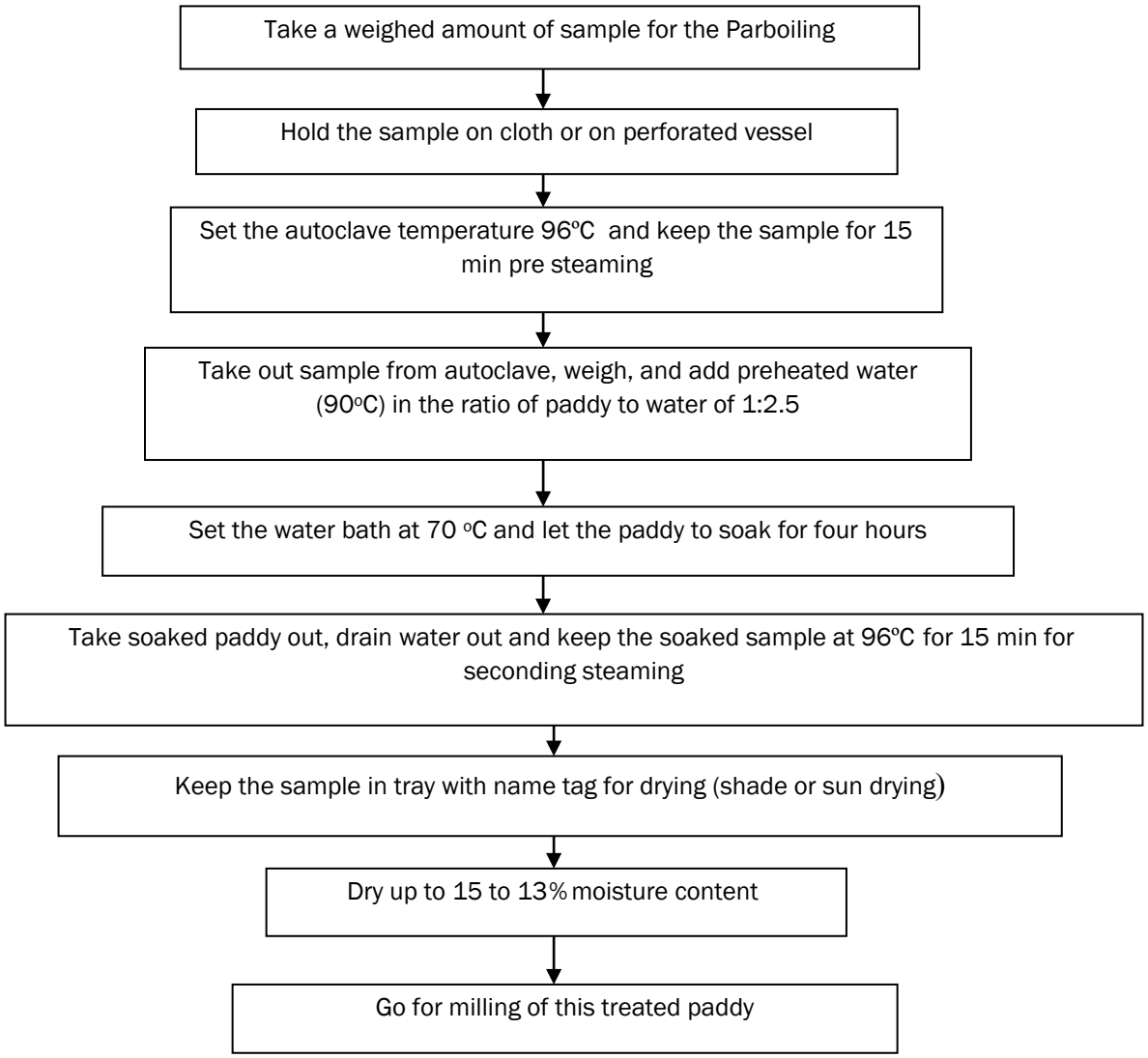

Figure 2. Parboiling process of paddy.

Shade or sun drying was done in the next stage along with the respective tagging of the samples.

Drying was continued till reaching 13 to 15% moisture content. Milling was done for the treated paddy at the final stage of the process (**Figure 2**).

Parboiling Process of Paddy

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The whole process of parboiling is shown in the following (**Figure 2**) follow chart.

Figure 2 Process flow chart for paddy processing- parboiling, drying and milling

Milling Operation of Paddy

The milling operation follows the steps as mentioned in **Figure 3**. In this process, parboiled paddy was selected and moisture content was estimated. Dehusking of the same was done in the next stage. Brown or whole rice was extracted from the dehusked sample and broken rice was isolated and only the whole grains were considered. Next polisher was used for polishing the rice grains and once more broken rice grains found during polishing was removed from the sample. Only whole rice was considered in the subsequent stage of the study (**Figure 3**).

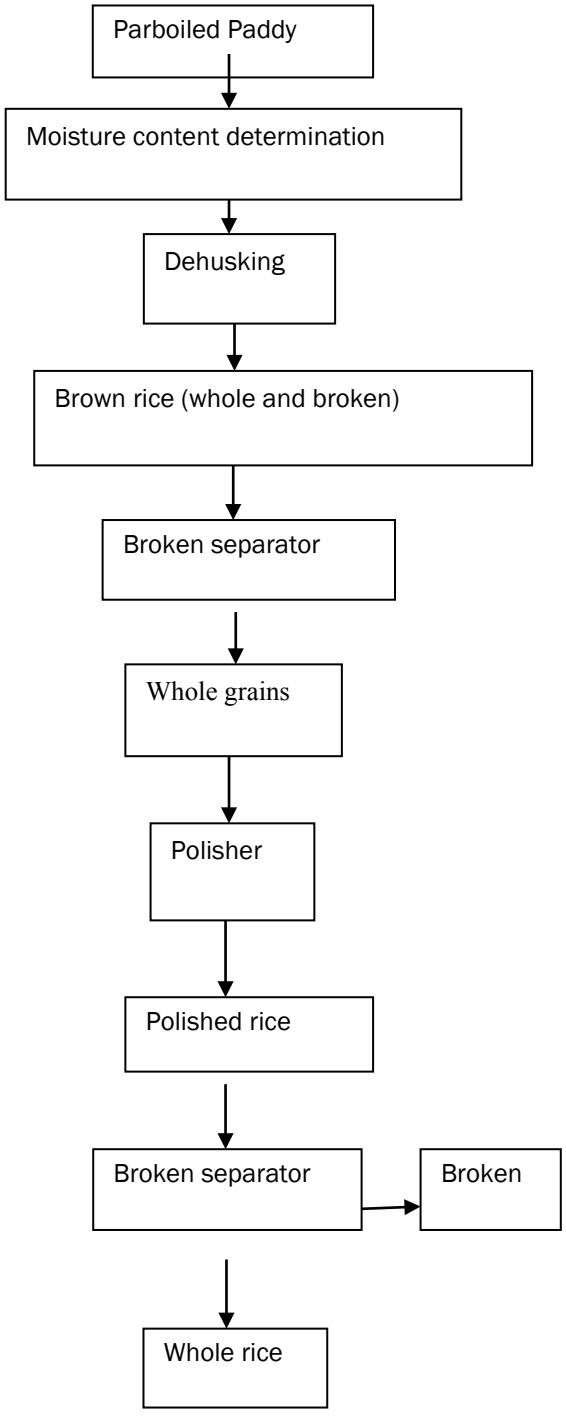

Figure 3. Milling operation of paddy.

In this process, percent husk (WH) and percent whole rice after dehusking (%WW) was calculated following the below mentioned formulae. Similarly, %Broken after dehusking (%W_B), Total yield (%TY), broken % after final polishing (%W_{B1}) and Head yield (%HY) was also calculated as described in the following section.

$$\% \text{ Husk (WH)} = \frac{W_H}{W} \times 100$$

Where, WH is husk weight in grams. W is total parboiled paddy taken for the milling in grams. Here is 250 grams for each sample.

% Whole rice after dehusking (%WW) $= \frac{W_W}{W_{Br}} \times 100$

Where, WW is the weight of whole rice.

% Broken after dehusking (%WB) $= \frac{W_B}{W_{Br}} \times 100$

Where, WB is weight of broken in grams. WBr is the total weight of brown rice.

Total yield (%TY) $= \frac{W_P}{W} \times 100$

Where, WP is the total weight of polished rice in grams (head and broken rice).

Broken % after final polishing (% W_{B1}) $= \frac{W_{B1}}{W_P} \times 100$

Where, WB1 is the weight of the broken after polishing.

Head yield (%HY) $= \frac{W_H}{W} \times 100$

Where, WH is the total head yield obtained.

RESULTS and DISCUSSION

Parboiling process for paddy was developed to reduce the amount of breakage grains, to retain the nutrition quality in the paddy such as, mineral content, vitamin content in the grains etc. and this process also aided in raising the long life of the polished final product and helped in long time storage before retail selling in the market. The obtained result in this study is provided in detail in the following section and discussed accordingly. Paddy samples considered for this study was evaluated at every step, such as before steaming and soaking (**Table 1**), after soaking and second steaming (**Table 2**), comparative output received for the samples considered (**Table 3**), analysis of the moisture content (**Table 4**), analysis of the samples after drying (**Table 5**), milling (**Tables 6 and 7**), obtained head and broken rice (**Figure 4**) and the obtained bran (**Figure 4**). A similar study was reported by [6] on effects of moisture content, variety and parboiling on milling quality of rice as a function of milling recovery, head rice yield, degree of milling and whiteness.

Table 1. For normal oven moisture content determination of sample before steaming and soaking (Time: 11:19 am (10-10-2011) to 11:20 am (11-10-2011).

Sample name		Crucible weight	Sample weight	Sample + crucible weight	After drying sample + crucible weight	Sample weight after drying	Crucible weight after drying	% moisture content
AVAXI	(a)	17.52	10.72	28.24	26.98	9.35	17.63	12.78
	(b)	18.02	10.28	28.30	27.09	9.07	18.02	11.77
424	(a)	18.59	10.30	28.89	27.60	9.01	18.59	12.55
	(b)	18.43	10.12	28.55	27.24	8.83	18.41	12.75

Table 2. For oven moisture content determination after soaking and second steaming.

Sample name		Crucible weight	Sample weight	Sample + crucible weight	After drying sample + crucible weight	Sample weight after drying	Crucible weight after drying	% moisture content
AVAXI	(a)	17.96	17.99	35.95	29.12	11.17	17.95	37.91
	(b)	18.38	15.77	34.15	28.29	9.93	18.36	36.99
424	(a)	18.98	16.26	35.24	28.43	9.45	18.98	41.90
	(b)	19.58	17.32	36.89	29.44	9.87	19.57	42.99

It was observed before steaming and soaking along with the normal oven moisture content that percent moisture content was found higher in AVAXI with 12.78% rather in 424 named sample which was 12.75. The range of moisture obtained was higher in AVAXI (11.75 to 12.78) rather than 424 variety (12.55 to 12.75). Therefore, suggesting restricted soaking capacity in the later variety (**Table 1**).

After soaking and performing the second steaming it was found that the same trend was continuing where it was seen that AVAXI was having moisture content in between 36.99% and 37.91% compare to higher moisture content in 424 variety with 41.90% and 42.99% of moisture (**Table 2**).

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Table 3. Major observation data at a glance.

Sr No	Content	AVAXI (g)	424 (g)
1	Weight of sample before steaming	301.82	338.43
2	Weight of sample after steaming	356.21	339.25
3	Weight of sample before soaking	356.21	339.25
4	Amount of water added after pre steaming	754.55	848.13
5	Weight of sample after soaking	426.02	451.97
6	Weight of sample after second steaming	426.00	451.26
7	Weight of sample before drying start	392.25	417.68
8	Weight of sample after drying	270.69	285.84

Table 4. Soaking characteristics for quick water soaking in raw paddy during parboiling process.

Time (min)	Sample weight (g)		% Moisture content	
	AVAXI	424	AVAXI	424
0	356.21	339.25	12.28	12.65
30	361.01	350.12	16.32	13.21
60	368.21	362.12	21.32	19.32
90	375.12	371.21	26.21	24.32
120	382.12	383.24	31.52	28.32
150	388.12	390.54	35.26	34.21
180	390.32	402.21	36.21	39.21
210	392.10	417.20	37.01	42.12
240	392.25	417.68	37.45	42.45

Table 5. Sample sun drying.

Time	Sample weight (g)		% Moisture content	
Total time (min)	AVAXI	424	AVAXI	424
00.00	392.25	417.68	30.99	31.57
120.00	378.32	402.32	29.12	29.21
240.00	362.12	395.21	27.12	28.21
360.00	352.12	390.12	25.32	27.52
480.00	345.12	388.12	23.12	26.56
600.00	339.24	384.32	20.12	25.32
720.00	336.12	382.17	19.46	25.21
840.00	311.41	343.98	16.07	16.90
960.00	300.12	301.23	15.02	14.23
1080.00	280.12	290.12	14.65	14.21
1140.00	270.69	285.84	13.55	13.95

Table 6. Milling observation data.

Sr No	Rice content	AVAXI	424
1	Moisture content of sample	13.55	13.95
2	Weight of paddy taken for milling	250.00	250.10
3	Weight of brown rice (whole + broken)	189.80	188.80
4	Weight of whole rice after dehusking	181.30	183.00
5	Weight of broken rice after dehusking	8.50	5.80
6	Weight of husk	60.20	67.10
7	Weight of polished rice (head + broken rice)	168.40	161.70
8	Weight of polished head rice	100.80	28.40
9	Weight of polished broken rice	67.60	133.30

The observed details are summarized in **Table 3** where higher weight of the sample before steaming was found for 424 variety and quite opposite result was observed after steaming (**Table 3**). Similarly, other observations are jotted down in **Table 3** which includes the comparison of weights noted before and after soaking, before and after drying etc.

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Table 7. Milling Results.

Contents	AVAXI	424
% Husk	24.08	26.84
% Broken after dehusking	4.48	3.07
% Whole rice after dehusking	95.52	96.93
Total yield	67.36	64.65
% Broken after polishing	40.14	82.43
Head Yield	40.32	11.36

Figure 4. Representation of the samples in different form, i.e., head rice, broken rice and bran obtained for AVAXI and 424 varieties.

Observed moisture content along with time is documented in **Table 4** where till 240 minutes (4 hours) data is shown. The initial weight recorded for AVAXI was 356.21 g and for 424 variety was 339.25 g. After four hours of soaking it was noted that AVAXI was containing weight of 392.25 g and 424 was having 417.68 g. It was observed in this study that the moisture content was higher in 424 variety with 42.45% whereas for AVAXI it was 37.45%.

Drying: As mentioned in the previous section of this article that sun drying was chosen as a drying option for the paddy samples under consideration in this study. Drying with time and moisture content for both the varieties are provided in Table 5 which suggests that after drying moisture content was higher in 424 variety (13.95%) rather than AVAXI type (13.55%).

Milling results: In continuation of this study, observations noted during milling are provided in Table 6. It was found that there is a significant variation for the weight of final polished head rice and polished broken rice in both the varieties as suggested by **Table 6** [7,8].

While comparing the milling output it was observed (**Table 7**) that percent husk was higher in 424 variety, percent broken after dehusking was higher in AVAXI, whole rice content after dehusking was higher in 424 sample and the total yield was maximum in AVAXI sample (**Table 7**).

The representation of the samples worked upon is provided in **Figure 4**.

CONCLUSION

A new parboiling method was introduced to improve the parboiling time, milling yield and intrinsic quality of rice. The quick parboiling was found to be faster and time saving process for paddy parboiling and drying. It is also economical because sun drying is involved in it. While comparing the varieties of rice undertaken for this study, different physicochemical behaviour was observed for both the varieties along with variable moisture content in different stages of the study. Future large scale analysis with multiple varieties will yield better understanding about various aspects of moisture containment of rice grains and will aid in establishing the relationship with respect to parboiling event.

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