

## STANDARDISE THE QUALITY PARAMETERS OF RED RICE PARBOILING PROCESS PRACTICES IN JAFFNA PENINSULA

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### Introduction

Rice is a staple food in Sri Lanka. Sri Lanka has average extent of paddy land 850,000 ha for cultivation. Paddy is the livelihood of more than 800,000 farm families and more than 30 % of total labour force is directly involved in rice production. Total annual rice production is around 2.6 million MT. Paddy has to be processed to produce quality parboiled rice. Northern Province covers 7566 ha of paddy land (2008). Most Sri Lankan consumes rice daily and the daily per capita consumption is around 100 g. /day.

Sri Lanka has started to import rice from abroad for as to meet country demand. It is vital to have scientific research on the post harvest processing of paddy especially on parboiling process to produce quality parboiled rice by minimizing all possible bottle necks in processing. Northern province has a huge potential to produce paddy which contribute our national production. There have been no scientific researches done on parboiling process of paddy grains so far in the Northern province though it contributes to the total National paddy production. There are local parboiling processing units operated and running in the Northern province to process paddy grains. But their quality of the end product is in question. Thus it is much more important to do scientific research on parboiling process in the Northern province of Sri Lanka with an intention of producing parboiled rice with SLS. Further there are no proper disposal methods for disposing waste water effluents generated from parboiling unit, though it has an ability to stimulate plant growth as of its nutrients content. Open dumping of such an effluents is a big problem in Jaffna and it causes many health hazards. Hence it is essential to investigate such effluent to find out available possible mean to use it in an effective manner.

Rice parboiling is a hydrothermal process applied as a treatment prior to the normal milling stage. Paddy parboiling is certainly the most ancient process, which has practical advantages are edible rice contain less broken and good taste ,flavor and hardness for cooked product to suit the consumer, and that can be stored for longer time without being sticky and rancid. The parboiling process is to produce physical, chemical and organoleptic modification in the rice with economic and nutritional advantages. Whatever may be the method of parboiling some of the main advantages are, the milled rice yield and head rice yield are higher than raw paddy milling and keeps longer and more resistance to insect attack Pillaiyar, P. (1988). Paddy soaked in water at ambient temperature (20-30<sup>0</sup>C) takes 36 to 48 hours to reached 30% moisture content, where as in hot water (60 to 65<sup>0</sup>C), it takes only 2 to 4 hours. Generally saturated steam at a pressure of 1 to 5 kg/cm<sup>2</sup> is used for steaming, steaming duration depends on the steaming arrangement, and steam temperature at atmospheric pressure, it is always higher than that at which needed for gelatinization Athapool, N. (2000). The purpose of steaming is to increase the milling yield and to improve storage characteristics and eating quality. It improves the firmness after cooking and achieves better vitamin and salt retention in the milled rice. During steaming process the moisture content of the paddy rice increases because of the extra water formed by

condensation. Water soluble substances spread inside the paddy grain, the granular texture of the endosperm become pasty during to gelatinization of starch. The cracks in the caryopsis become sealed and the texture of the endosperm becomes more compact Palipane.K.B. (2000).

The objective of this study is to optimize the parameters in term of head rice yield of parboiling process of red pericarp paddy.

### Methodology

Raw paddy (Moddaikarupan – Jaffna Local), Water bath (Atmospheric temperature), Steam Cooker, (Boiler -100°C) , Hot air circulatory Oven (60°C), Electronic balance, Stop watch, Grain Counter, Huller, Polisher, Grader, Whiteness tester, White belly tester, Heat damage tester.

Parboiling can be explained by the following line diagram



The paddy sample (Red pericarp rice) was cleaned before soaking. Paddy was soaked in a water bath for 48 hours at atmospheric temperature. After soaking the excess water was drained-off then soaked paddy sample was steamed in a steam cooker at the pressure of 0.5 kg/cm<sup>2</sup> for 1hr, 2 hrs and 3 hours durations. Triplicate was made for each control groups. Finally drying was done at two stages; first paddy sample was tempered under dryer and then aged at atmospheric temperature until the paddy sample reached a moisture content of 14 %. Then 500 g of each sample was milled by Satake huller and polished for 2 min by using Satake Polisher. The weight of milled rice was recorded. The parameters for evaluating the quality of parboiled rice were determined which analyzed by statistically using standard statistical packages.

### Sample Preparation

Paddy lot will be blown by a blower during the process of pre cleaning. Treatments (T1, T2, T3,....T5) will be developed in soaking, steaming (steeping), cooling, tempering and drying steps of the processes to find out appropriate combination for processing the following combinations of treatments can be developed.

T1- Raw Paddy (Un-soak and un-steamed)

T2 – Soak alone

T3 – Soak and steam an hour

T4 – Soak and two hour steaming

T5 – Soak and three hour steaming

### Discussion and Conclusion

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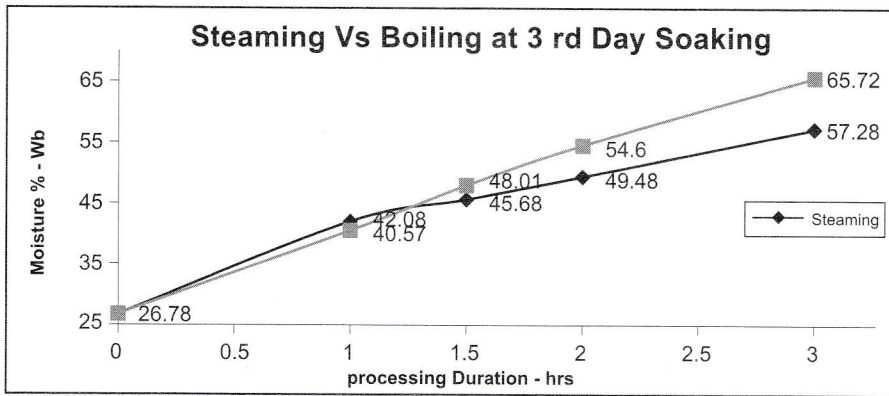


Figure 1: The effect of steaming, boiling and soaking duration in parboiling process

Figure 1 shows the relationship between moisture content (wb) and processing duration (hrs) was investigate the effect of processing mode steaming and boiling. The mode of steaming was better than boiling in the term of moisture absorption nature. During process 3 hours steaming was enough to reach the optimum moisture content of 60%. But in boiling process the moisture level was exceed the optimum limit, so that it was difficult to dry at the level of moisture for milling. Therefore steaming was a good way of parboiling process.

Figure 2 shows the relationship between rice yield (%) and five different treatments were practiced to investigate the effect of steaming on head rice yield of parboiling process under different treatment conditions. As steaming duration increases head rice yield of samples steamed for 1 hour & 2 hour, increases at increasing rate. Where as it increases at decreasing rate for samples steamed for 3 hours. Head rice yield increases from 66.2% to 70.4%, with an increment in steaming duration.

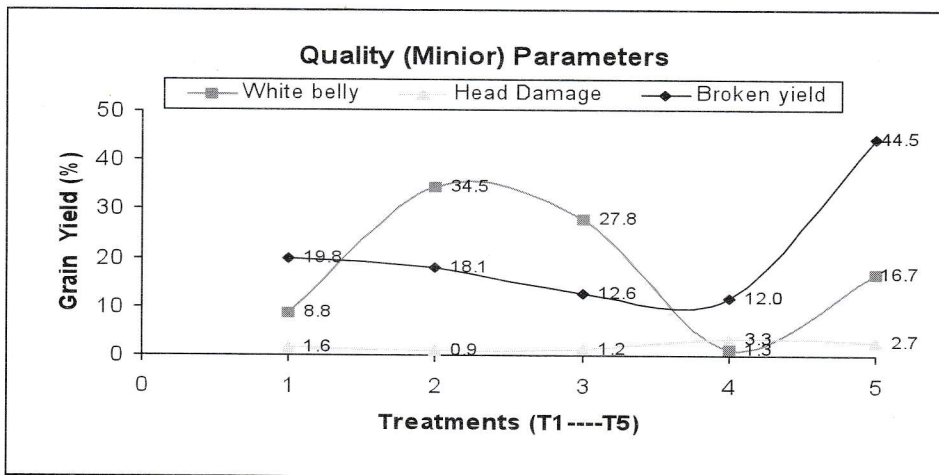


Figure 2: The effect of steaming effect on the milled, head rice and broken yield

It is clear, from the results that the increment in steaming duration increase higher percentage of head rice yield which is said to increase rice outturn of the particular process practiced for processing. Critical change has been observed from 3 hour of steaming onwards in the head rice yield of the samples steamed for an hour & 2 hour. But, head rice



yield is getting stabilized after two hour of steaming of the sample. Soaking increases moisture content from 14% to 30% where as steaming make the grains to absorb moisture up to 38%.

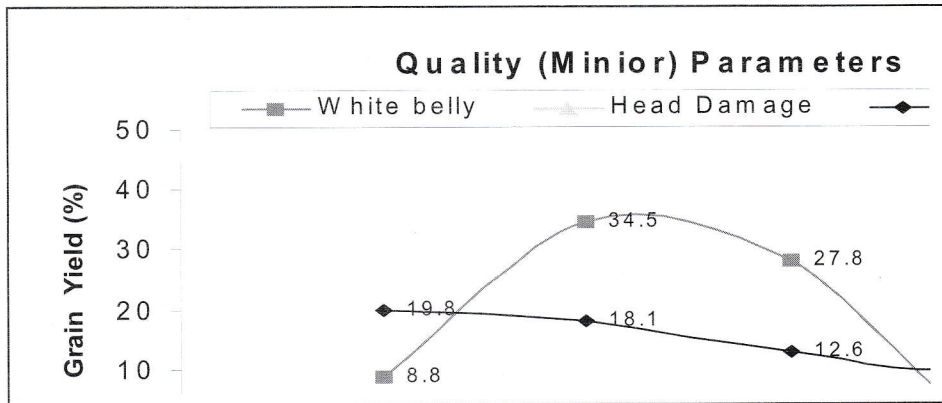


Figure 3: The effect of steaming effect on the broken rice yield, white belly and heat damage

Further, soaking & steaming cause numerous physicochemical changes in the grain to convert its properties different from raw rice. Enough moisture absorbed to disintegrate protein molecules & gelatinize starch during steaming. This process will help to seal the cracks present in the rice caryopsis. It will in turn make the grains harder to yield higher percentage of head rice. Therefore, it is clear that soaking & steaming will increase the head rice yield in the milled rice.

Figure 3 shows the relationship between broken rice yield, white belly and heat damage at different steaming duration of three different samples steamed for one hour, two hour and three hour. Head rice yield and broken rice yield are having reciprocal relationship as they are inter dependent. Considerable changes are observed three hours of soaking onwards for the samples steamed both an hour and two hour. But, broken rice percentage diminishes drastically from an hour steaming to two hour steaming of the samples steamed for three hours.

It is clear that steaming is dominant in determining broken rice percentage of parboiling process. But, combine effect of soaking and steaming is influence milling recovery lowest percentage of broken rice was obtained from the samples steamed for two hours. It is therefore concluded that an increment in steaming duration increases head rice yield with a reduction of broken kernels.

Degree of the seal determines milling recovery of parboiling process, which is made in the process of starch gelatinization during steaming. Parboiled rice is translucent because any chalkiness inside rice kernel disappears during steaming. So no light scattered and diffracted during detector process.

The result reveals that steaming 2 hrs duration has almost very less white belly and un-soaked steamed rice kernel had highest white belly. The heat damaged grains are increased with the increase of steaming time was found to be more in 3 hrs steaming. There was significant difference among treatments in un-soaked un-steamed, soaked un-steamed and

soaked steamed. Un-soaked un-steamed sample gave highest whiteness value while soaking and steaming samples gave lowest whiteness values. Reason is soaking and steaming produce many water soluble pigments get them out to the kernel surface and make parboiled rice less white.

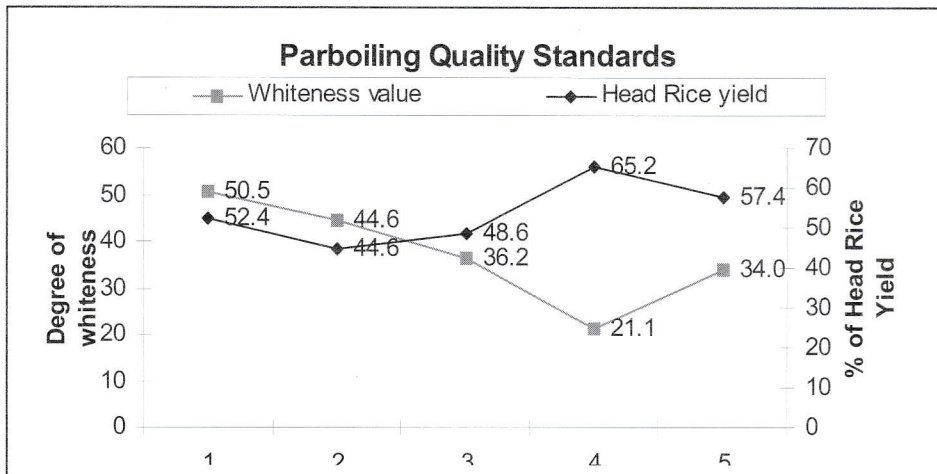


Figure 4: is shows the relationship between color and head rice yield

Figure 4 is shows the relationship between color and head rice yield of five different treatments with steaming duration of three different samples tested for an hour 2 hour and 3 hour. Color is the factor determines polishing degree of the rice samples obtain from parboiling process. Head rice yield increases with an increase in steaming duration as enough moisture is essential to make rice caryopsis stable and along to resist breakage. Colour is depends on the degree of bran removed from the processed grains. As grains become transparent whiteness will come down. Steaming for 2 hours yield higher head rice yield with less whiteness value as this combination makes the grains harder and translucent.

Table - 1 : Statistical Analysis of the treatments significance

Anova: Two-Factor With Replication						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows -Replicates	13.90	4	3.47	0.04	1.00	2.78
Columns - Treatments	19695.98	6	3282.66	38.93	0.00	2.51
Error	2023.77	24	84.32			
Total	21733.64	34				

Parboiling process (soaking and steaming) could improve the milling characters of raw paddy, it resulted in more milling yield, more head rice yield, lesser broken rice and lower white belly percentage while soaking 48 hours with two hours of steaming duration was found to be best. Result from this study revels soaked alone, soaked without steamed paddy showed less significant with soaked-steam paddy in terms of milling yield and head rice

yield white belly and whiteness. Though investigated parameters showed that parboiled rice was better quality in terms of head yield than un-parboiled rice and there were no significant difference among triplicates of the treatments.

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