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Effluent Changing Interval Effects on hydration properties and milling recovery of two different Rice Varieties.

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Abstract : Parboiling is the hydrothermal treatment applied to the paddy grains before milling in order to increase the milling recovery. Parboiling process consist three stages such as soaking, steaming and drying. In this study the effects of effluent changing interval on milling yield of two different paddy varieties were estimated. In addition to that, the evaluation of characteristic effluent and hydro profile of paddy also were done. Paddy varieties of Department recommended variety BG 360 and industrial preference variety *Addakari* were soaked in water at ambient temperature. Two experimental setups were designed for both varieties with changing the effluent at each 12 hour interval and 24 hour interval within 48 hour duration. At every 6 hour interval, effluent samples were collected for characterization. After 48 hours of soaking, paddy grains were steamed till few of their hulls split off. It was then cooled and sun dried until the moisture reduced up to 14%. Analytical grade de-husking and polishing machines were used for the milling. In the milling yield analysis, *Addakari* rice variety with changing the effluent at 12 hour interval resulted higher, total milled rice yield percentage, brown rice percentage and degree of milling percentage as 73.66%, 81.77% and 90.08%, respectively. The head rice percentage was 68.26 % to the same variety but with changing the effluent at 24 hour interval. The rice variety BG 360 with effluent changed at 24hr interval yielded higher hull percentage as 21.66%. The whiteness value of BG 360 with changing the effluent at 12 hour interval was higher than other treatment and that of other variety as 27.8%. It resulted in higher hydration profile of BG 360 rice variety, due to the larger surface area. When considering the effluent characteristic with different changing interval of effluent, the treatment with time interval of 12 hour showed lesser level contaminants in the effluent, which can be utilized for the secondary purposes like irrigation. According to this study, it was identified that effluent changing interval, influences the milling yield, hydration profile and physical properties of different rice varieties.

Keywords: Drying, Effluent, Head rice percentage, Milling yield, Parboiling, Soaking

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Introduction

Rice is the major food grain of Sri Lankans and plays a vital role in the economy as well as livelihood of people. Rice production in Sri Lanka showed a remarkable increase during the last few decades due to provision of irrigation water, improved varieties, better cultural practices and increased agrochemical applications (Banda, 1999). Paddy grains are processed into rice either as parboiled or raw rice forms. Parboiling is meant as partial cooking of paddy grain to achieve a certain hardness of kernel with high percentage of head rice yield after husking (Sareepuang, 2008). This process is developed to improve the quality of the rice, which consists soaking, steaming and drying of rough rice. Breakage of grains occurs during the milling due to the cracks developed during maturity of paddy grains. However, these cracks can be eliminated by proper soaking and steaming. The amount of water required for soaking paddy is about 1.3 times the weight of paddy (Wimberly, 1983).

Parboiling with gelatinizing of rice starch and elimination and filing rice seed chaps, results in improved resistance of seeds against exerted tensions during paddy threshing operations. Also, nick percentage is reduced significantly, operation percentage increases and because of leakage and penetration of bran into the rice seed, bran percentage is reduced significantly and crust percentage is reduced slightly to, which justifies operation percentage improvement (Kshirod *et al.,*1966). Parboiling causes physical and chemical modification in the grain, leading to favorable changes, such as easier shelling, higher head rice yield, fewer broken grains, increased resistance to insects, firmer cooked rice texture, less solid loss during cooking, better retention of nutrients for examples protein, vitamin, mineral and higher oil content in the bran (Pillaiyar, 1988).

Milling of brown rice kernel includes removal of bran and germ from underlying endosperm. Head rice percentage is the key parameter to estimate the milling efficiency. Generally, parboiling increases the head rice yield. The factors influencing milling of rice are important considerations in the processing of rice. The pre-milling conditions mostly determine the milling quality of the paddy grain. Therefore this study aimed to investigate the effects of soaked-water changing interval on rice milling yield, hydration and physical properties of two different parboiled rice varieties.

Objective of this Study

To investigate the effects of soaked-water changing interval on quality rice milling yield

Materials and Methods

Soaking

Samples of BG 360 and *Addakari* rice varieties were selected for this study. The cold soaking was carried out for both selected rice varieties. The samples were soaked in four different plastic vessels as two vessels per each variety with 1 kg of sample in reverse osmosis water at ambient temperature. For the one set of sample, the effluent was changed at every 12 hour interval and 24 hour interval for the other set of sample, within 48 hours of time duration.

Steaming

After 48 hours of soaking, steaming was done by using laboratory steamer. It is a thermal process, which leads to gelatinization without removing any moisture from rice. The splitting of husk of few paddy grains was considered as completion of steaming.

Drying

The steamed paddy was wide spread on the cement floor and then sun drying was carried out. The final moisture content of the dried paddy was checked by using the moisture meter as 14%. After drying is completed, the paddy was allowed to stand for 2 days before milling to permit internal moisture difference and stresses to equalize.

Milling Yield Analysis

Analytical grade de-husking and polishing machines were used for the milling. Rough rice samples were de-husked for removal of husk. The brown rice and hull were weighed. The brown rice was polished to remove the bran to a certain level. Then, the milled rice sample was weighed. 100g of milled grain from each experiment were weighed and the head rice was separated manually and the weight was measured by using an electronic balance. Milling yield was determined by using IRRI formula.

Whiteness Value

The whiteness value was measured by whiteness tester. It was pre-calibrated using ceramic plate. Then the polished samples were placed and displayed value was recorded as whiteness value.

Other Physical Parameters

The length and width of the grains were measured by using vernier caliper. The electronic balance was used to measure the 1000 grain weight and other needed weight measurements.

Hydration Profile

The moisture content was measured by using oven. 5g of each sample was weighed by using electronic balance in a weight known moisture can and placed in the oven at 103°C until the constant weight was obtained. After drying, the moisture can was allowed to cool and then weighed immediately.

Results and Discussion

Table 1: Milling yield analysis

Variety	Brown rice %	Hull %	Total milled rice %	Head rice %	Degree of milling %
A-NP	81.90	18.10	73.55	38.56	89.80
A-12	81.77	18.16	73.66	61.89	90.08
A-24	81.66	18.33	73.53	68.26	90.04
B-NP	78.48	21.52	70.05	49.99	89.25
B-12	78.44	21.56	70.40	60.72	89.75
B-24	78.34	21.66	70.14	66.70	89.53

A-NP, *Addakari* Non-Parboiled; A-12, *Addakari* with effluent changing at 12 hour interval; A-24, *Addakari* with effluentchanging at 24 hour interval;B-NP, BG 360 Non-Parboiled; B-12, BG 360 with effluentchanging at 12 hour interval; B-24, BG 360with effluentchanging at 24 hour interval.

Table 1 shows the analysis regarding milling yield. Rice varieties processed as raw resulted with poor milling yield than the parboiled rice due to the gelatinization occurred during parboiling process. The overall yield of *Addakari* was higher than BG 360. This is due to morphological differences of selected varieties. *Addakari* shows higher resistance for breakage during milling compared to BG 360. When comparing the effluent changing interval, 12 hour interval shows better yield for both varieties. This is due to quick and uniform water absorption and removal of contaminant containing effluent more frequently compare to effluent changing at 24 hour interval.

Table 2: Comparison of physical properties

Variety	Length (mm)	Width (mm)	L/W ratio	Shape	Color	1000grain weight (g)	Whiteness value
A-NP	5.69	2.55	2.23	Medium	Red	20.26	
A-12	5.63	2.51	2.51	Medium	Red	20.10	18.4
A-24	5.65	2.54	2.54	Medium	Red	19.21	15.1
B-NP	4.36	2.06	2.11	Short	White	11.84	
B-12	4.30	2.02	2.12	Short	White	11.54	27.8
B-24	4.31	2.04	2.11	Short	White	10.61	23.9

A-NP, *Addakari* Non-Parboiled; A-12, *Addakari* with effluent changing at 12 hour interval; A-24, *Addakari* with effluent changing at 24 hour interval; B-NP, BG 360 Non-Parboiled; B-12, BG360 with effluent changing at 12 hour interval; B-24, BG360with effluent changing at 24 hour interval.

Table 2 shows the comparison of physical properties of paddy varieties with different effluent changing interval. Based on the initial morphological characteristic of the varieties the significant changes have taken place in the physical properties.

Thousand grains weight and was less for parboiled rice, particularly for the experiment with effluent changing interval at 24 hour, due to leaching of starch during soaking. The whiteness value also shows the same pattern of result as thousand grains weight due to leaching of pigments and most of the bran during soaking and steaming.

Hydration Profile

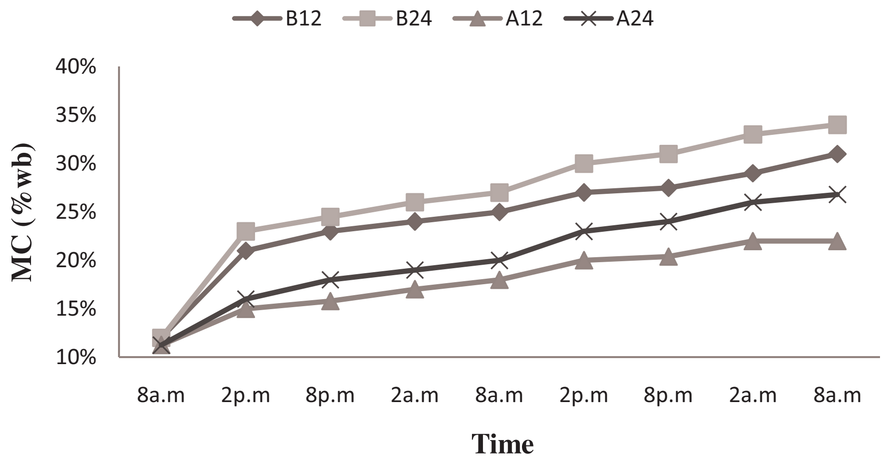

Figure 1: Changes in moisture content of effluent with soaking time

Figure 1 shows the relationship between moisture content (wet basis) and the soaking time. All the curves follow a similar pattern. Hydration rate increases as soaking time goes up in both varieties. Due to the larger surface area of BG 360 rice variety, it resulted in higher hydration profile.

Effluent Characterization

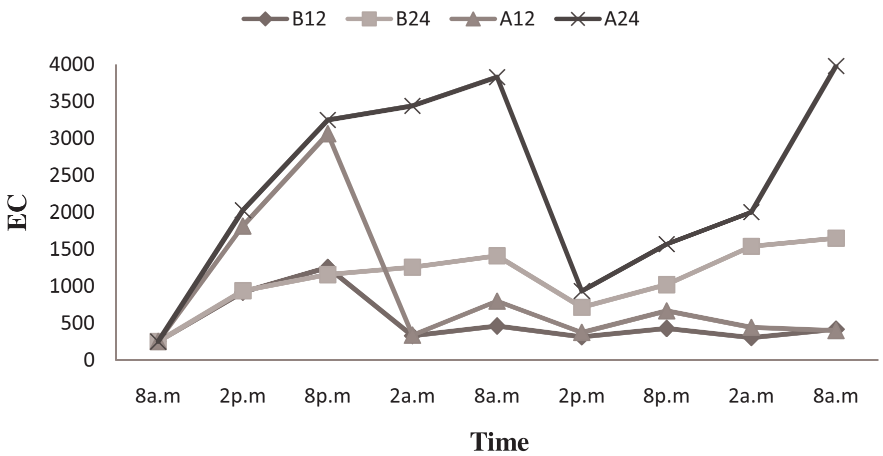

Figure 2: Changes in electrical conductivity of effluent with soaking time

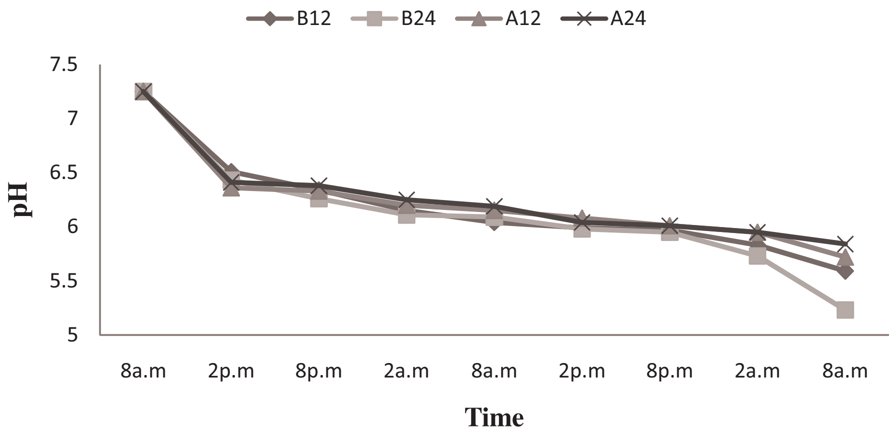

Figure 3: Changes in pH of effluent with soaking time

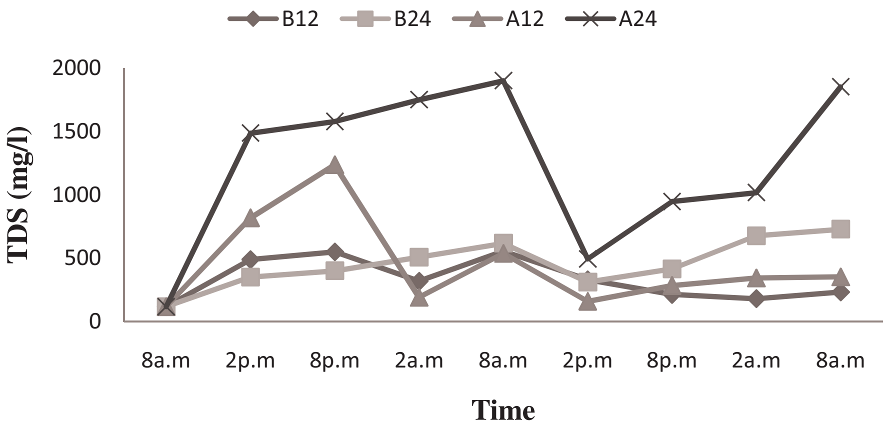

Figure 4: Changes in total dissolved solids of effluent with soaking time

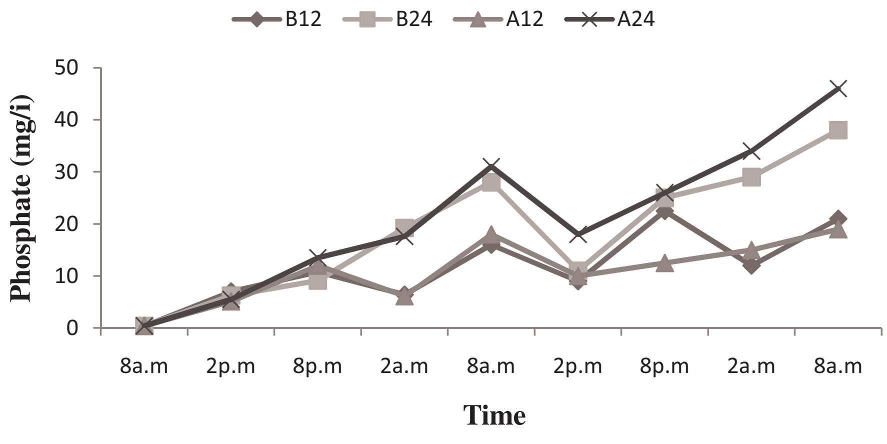

Figure 5: Changes in phosphate of effluent with soaking time

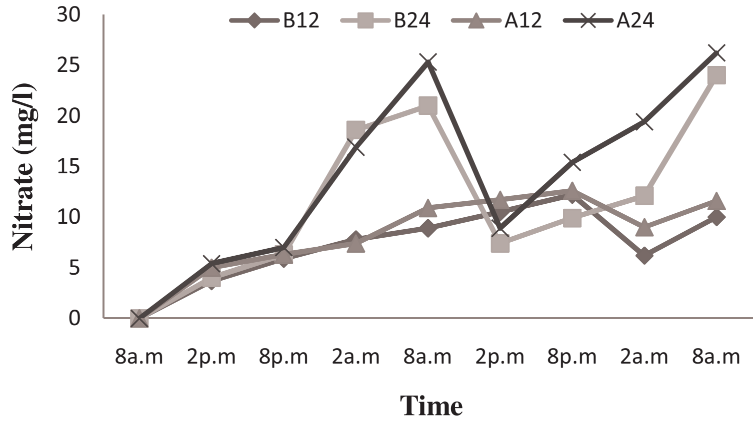

Figure 6: Changes in nitrate of effluent with soaking time

Figure 2, 3, 4, 5 and 6 shows the electrical conductivity, pH, total dissolved solids, and phosphate and nitrate content changes in the effluent with different treatments, respectively. The treatment with time interval of 12 hour showed lesser level contaminants in the effluent, which can be utilized for the secondary purposes like irrigation.

Conclusions

In the milling yield analysis, *Addakari* rice variety with changing the effluent at 12 hour interval resulted higher, total milled rice yield percentage, brown rice percentage and degree of milling percentage as 73.66%, 81.77% and 90.08%, respectively. The head rice percentage was 68.26 % to the same variety but with changing the effluent at 24 hour interval. The rice variety BG 360 with effluent changed at 24hr interval yielded higher hull percentage as 21.66%. The whiteness value of BG 360 with changing the effluent at 12 hour interval was higher than other treatment and that of other variety as 27.8%. It resulted in higher hydration profile of BG 360 rice variety, due to the larger surface area. When considering the effluent characteristic with different changing interval of effluent, the treatment with time interval of 12 hour showed lesser level contaminants in the effluent, which can be utilized for the secondary purposes like irrigation. According to this study, it was identified that effluent changing interval, influences the milling yield, hydration profile and physical properties of different rice varieties.

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