Effect of Chloride Iron in Soaking Water for Altering Parboiled Rice Quality

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Abstract

Parboiling of rice is an ancient traditional process of Asian countries and it reduces the level of grain breakage and increase in head yield of rice during milling. Generally, parboiling process consists of three major steps i.e. soaking of cleaned paddy up to saturation moisture content, gelatinization of rice starch by adding heat to the moist kernels through steaming, and drying the product to moisture content suitable for milling or storage. Parboiling is also improved nutritive and some sensory qualities of rice. The market demand of the parboiled rice depends on its quality parameters such as kernel broken grain percentage, head rice yield, kernel whiteness and hardness (texture). Even though many factors contributing in quality of parboiled rice, soaking water quality, soaking procedures and steaming procedures were impart effect on quality of parboiled rice. It can be observed, quality of parboiled rice varies from place to place in Sri Lanka although, parboiling treatments are similar. Underground water is the main water source used for soaking of paddy in parboiling. It was observed that lot of chemical such as $CaCO_3$, Cl irons; NO_3 and Fluoride irons are soluble in ground water available in dry zone of Sri Lanka where most of rice mills are located. Hence this research study mainly focused to evaluate, effect of chlorine in soaking water to alter quality of parboiled rice such as kernel whiteness, texture/hardness, broken grain percentage and head rice yield percentage. Results revealed that chlorine iron concentration of the soaking water significantly affects only for changing of rice kernel hardness (texture) in parboiled rice and also it does not change other rice quality parameters. And also effect of chlorine iron concentration in soaking water die not show any clear pattern for changing of rice kernel texture/hardness in parboiled rice.

Key words: Cl irons, Paddy parboiling, Soaking water, Rice qualities, Hardness

Introduction

Rice (*Oryza Sativa*) is the most important and extensively grown food crop in the world. Processing of paddy can be done as raw rice or parboiled rice. Generally, parboiling process consists of three stages: soaking the cleaned raw rough rice to attain saturation moisture content, gelatinization of rice starch by adding heat to the moist kernels through steaming, and drying the product to moisture content suitable for milling or storage. Soaking is the most time consuming operation in parboiling and also significant amount of water is consumed for soaking process (Igathinathane et al 2005).

Ground water is main water source for soaking process in paddy Parboiling. Ground water quality varies from place to place in Sri Lanka according to the different aquifers present in different regions (Panabokke and Perera 2005). Chemical water quality parameter of ground water varies from place to place according to the aquifer nature found in those regions and quality of parboiled rice also varies within different regions even though parboiling procedures are similar. There are many chemicals available in ground water i.e. calcium, magnesium, iron, manganese, sodium, sulfates, chlorides and nitrates. However, chloride irons are prominent in some dry zone areas of Sri Lanka. This research study mainly focused to evaluate the effect of chloride iron concentration in soaking water for changing of parboiled rice qualities such as whiteness, hardness, broken grain percentage and head rice yield percentage. The main objectives of this study were evaluate the effect of chlorine iron concentration in soaking water in paddy parboiling for the final qualities of parboiled rice and observing of the pattern that varies of rice qualities with increasing of chlorine iron concentration in soaking water.

Materials and Methods

Soaking and steaming of paddy samples: Paddy samples were placed in to distilled water filled bucket. Then floated immature grains in the paddy sample were removed and also they were thoroughly washed to remove mud or dirty which may impart effect on final quality of paddy. These samples were soaked for 24 hours in different chlorine iron (Cl^-) concentrated water at ambient temperature (303). Different chlorine iron concentrated water samples were prepared according to the table 2.1. Experiments were replicated to 3 times. During the soaking water was changed at 8 hours interval to avoid developing of micro organism in paddy. Soaked paddy samples were undergone 6 minutes steaming to complete gelatinization of rice starch. Non pressurized steam was used for steaming.

Table 1: Different chlorine iron concentrations in water used for soaking of paddy Drying and milling of paddy samples:

Different $CaCO_3$ concentration mg/l							
100	300	500	7000	900	1100	1300	1500

Soon after steaming, paddy samples were spread trays and allowed to dry in an ambient temperatu Drying of paddy samples were performed until gra moisture content became 14%. Tempering of pad samples was also practiced during the moisture conte 20% -18%. Dried paddy samples were milled to remo husk and bran. Laboratory scale "Sattakki" rubber r sheller and abrasive polisher were used to remove hu and bran of paddy respectively. The 250 g of pad sample was used for milling in each treated sample a de-husked rice kernel was polished for 75 seconds.

Broken grain percentage = $(W_{b2}/W_m) \times 100$ ---- (1)

Head rice yield percentage = $(W_r/W) \times 100$ ------ (2)

W_{b2} = weight of broken grains, W_m = weight of polished rice, W_r = weight of head rice yield and W = weight of paddy sample

Broken grains percentage was calculated by representative working sample of milled rice of 100g and it was obtained by using sample divider. Grain particles, which are smaller than the $^3/_4$ of the grain, were considered as broken grains and they were separated by hand picking and broken grain percentage was calculated by Equation 1. Accordingly head rice yield percentage was calculated by Equation 2.

Measurement of rice kernel whiteness and hardness:- Rice kernel whiteness was measured by using Colorimeter. In Hunter scale L measures lightness (whiteness or darkness). The 'L' value varies from 100 for perfect white and zero (0) for perfect black. In this research study, L value (lightness value) was used as whiteness value. Compression test was carried out to find rice kernel hardness (yield stress). Rice hardness meter was used to measure the hardness of the rice kernel. The 12 rice kernels were randomly selected in each treated samples and hardness/yield stress was measured. Averages of these values were calculated as the hardness of the rice samples.

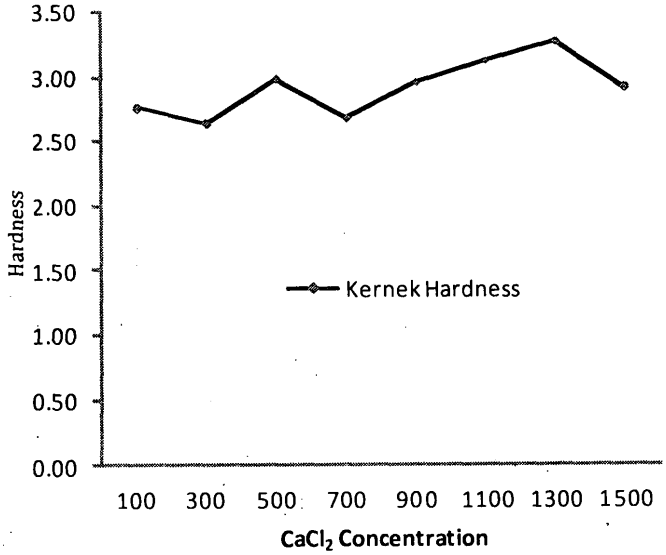

Figure 1: Change of rice kernel hardness with Cl-iron concentration in soaking water

Statistical Analysis:- Data on rice qualities (Kernel whiteness, hardness, broken grain %, and head rice yield %) were analyzed for variance (ANOVA) by General Liner Models (GLM) procedure of SAS and treatments means for individual resulted quality parameter were separated by the Duncan's Multiple Range Test (DMTR) at $\alpha = 0.05$ level of significance level.

Results and Discussion

It was observed that the quality parameters of parboiled rice such as kernel whiteness, hardness, broken grain percentage and head rice yield percentage were varied according to the chemical dissolve in soaking such as calcium carbonate, manganese carbonate, chlorides, fluorides and nitrate dissolve. In this study it was evaluated effect. i.e. increasing Cl^- iron concentration in soaking water to altering the above qualities of parboiled rice.

Figure 1 shows change of rice kernel hardness of the parboiled rice by the effect of Cl^- iron concentration in soaking water. It was observed that kernel hardness of the control sample (sample soaked from distilled water without Cl^-) was 2.46kg. The result clearly indicated that the Cl^- dissolve in soaking water significantly ($p<0.05$) vhanged rice kernel hardness/texture. However, there was no clear altering pattern or relationship in between Cl^- iron concentration in soaking with change rice kernel hardness/texture in parboiled rice.

Table 2 DMRT results for chloride concentrations

$CaCl_2$ concentrations		Mean rice kernel hardness	Mean broken grain percentage	Mean head rice yield percentage	Mean rice kernel whiteness
100	1	2.77^{cd}	0.15	75.55^{ab}	61.36
300	2	2.64^{d}	0.12	75.63^{ab}	61.64
500	3	2.98^{abc}	0.28	75.56^{ab}	62.20
700	4	2.68^{cd}	0.13	75.42^{ab}	61.60
900	5	2.96^{abcd}	0.18	75.60^{ab}	62.05
1100	6	3.12^{ab}	0.15	75.67^{ab}	61.08
1300	7	3.27^{a}	0.16	74.07^{b}	62.66
1500	8	2.93^{bcd}	0.09	75.98^{a}	62.68

Columns having same letter are not significantly difference at = 0.05 by DMRT

Effect of chlorine irons (Cl^-) concentration in soaking water for changing other quality parameters of parboiled rice

The result clearly indicated that the chlorine iron dissolve in soaking water had no significant ($p> 0.05$) effect for altering other rice quality parameters such as kernel whiteness, broken grain percentage and head rice yield percentage except rice kernel hardness/texture.

The result of the Duncan Multiple Range Test (DMRT) shows that increasing of Cl^- iron concentration in soaking water caused to change rice kernel in hardness of the parboiled rice. However, with different concentration of Cl^- in soaking water didn't show any prominent pattern of change in hardness/texture. Table 2 shows the DMRT mean values of rice quality parameters that that altering by Cl^- iron concentration in soaking water.

Conclusion

It can be concluded that Cl^- iron concentration of the soaking water significantly affected only for changing of rice kernel hardness/texture in parboiled rice. The Cl^- iron concentration in the soaking water wdid not significantly change other rice quality parameters such as kernel hardness, broken grain percentage and head rice yield percentage. Changing Cl^- concentration in soaking water was shown change of rice kernel hardness texture. However, it was not observed any clear pattern of hardness changing with Cl^- iron in soaking water.

Reference

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