Does Resistant Starch Content Vary with Processing? A study with Selected Traditional Rice Varieties of Sri Lanka

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Resistant starch (RS) includes starch and its degradation products that resist digestion in humans and confer many health benefits. Rice being our staple and with the current interest in consuming traditional rice varieties, the objective was to determine the change in RS content of six traditional rice varieties namely *Godaheenati*, *Batapola el*, *Dik wee*, *Dahanala*, *Unakola samba* and *Hangimuththan* when processed differently as raw under milled, raw polished (4%) and parboiled. RS content of cooked and uncooked differently processed flour (n=6) was determined by enzymatic assay with amyloglucosidase/α- amylase (Megazyme assay kit). Results are expressed as percentages and significances calculated (SPSS statistic package) at 95% confidence interval. RS content of raw cooked varied between 2-6% in the order of *Dahanala*> *Unakola samba*> *Hangimuththan*> *Batapola el*> *Godaheenati*> *Dik wee*. Raw polished cooked varieties had less (1-3%) in the order *Batapola el*> *Unakola samba*> *Hangimuththan*> *Goda heenati*> *Dik wee*. Increased ($p<0.05$) RS was observed in parboiled cooked varieties (6.5-10%) in the order *Dik wee*> *Hangimuththan*> *Goda heenati*> *Dahanala*> *Unakola samba*> *Batapola el*. Thus the RS contents of differently processed cooked rice increased ($p<0.05$) in the order of raw polished, raw and parboiled. However, all uncooked varieties had (<1.1%) significantly lower ($p<0.05$) contents. RS contents of cooked raw and raw polished varieties were significantly lower confirming the contribution made by retrograded starch to RS due to parboiling process. Thus parboiled varieties could be recommended for consumption by individuals seeking to decrease the energy intake.

Keywords: resistant starch, raw rice, parboiling, milling

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Introduction

Resistant starch (RS) includes starch and its degradation products that resist digestion in humans and confer many health benefits. Thus consumption of foods containing high RS content is important in prevention of non-communicable diseases. Parboiling of rice contributes to increase the resistant starch content when compared to raw or unparboiled rice due to starch retrogradation and other complex formation. Rice being the staple in Sri Lanka and with the current interest in consuming traditional rice varieties, the objective of the present study was to determine the change in RS content of six traditional rice varieties namely *Godaheenati*, *Batapola el*, *Dik wee*, *Dahanala*, *Unakola samba* and *Hangimuththan* when processed differently as raw under milled, raw polished and parboiled.

Methodology

Selection and processing of rice varieties:

Six traditional rice varieties (*Godaheenati*, *Batapola el*, *Dik wee*, *Dahanala*, *Unakola samba* and *Hangimuththan*) were differently processed as raw under milled, raw polished (4% polishing level) and parboiled under milled**.** Raw paddy was collected from the traditional rice preserving center at Homagama. Paddy was parboiled by immersing paddy in boiling hot water and heating until the paddy grains split open and sun drying. Milling and polishing of rice was done at Industrial Technology Institute.

Determination of resistant starch content:

Each rice sample was washed and one portion was cooked (as per home cooking), and both portions were oven dried at low temperature (40-45 ^{o}C), milled and seived (100 mesh size). Cooked and uncooked rice flour were used in the analysis.Total starch content was determined by Amyloglucosidase/ α- Amylase method by adding 2M KOH and Sodium acetate buffer. Digestible starch content was determined bydigesting with α- Amylase, incubating at 100 ^{0}C and digesting with Amyloglucosidase. RS content was calculated by reducing digestible starch content from total starch content.

SPSS statistic package was used in data analysis. (Descriptive statistics and ANOVA Tukey's posthoc test at 95% confidence interval)

Results and Discussion

Resistant starch content (%) of cooked and uncooked rice flour (dry weight basis) of six differently processed traditional rice varieties are shown in the table 1 below.

Table 1: Resistant starch content (%) of cooked and uncooked rice flour (dry weight basis) (mean±SD)

Variety	Raw		Raw polished		Parboiled	
	Cooked	Uncooked	Cooked	Uncooked	Cooked	Uncooked
Goda heenati	3.9 ± 0.4^{apq}	0.4 ± 0.2^{bp}	2.5 ± 0.5^{cpqrs}	0.6 ± 0.1^{bp}	8.3 ± 0.2^{dpqr}	1.0 ± 0.1^{bp}
Batapola el	4.4 ± 0.3^{apr}	1.0 ± 0.3^{bp}	3.3 ± 0.2^{cptu}	0.9 ± 0.2^{bp}	6.5 ± 0.7^{ds}	0.9 ± 0.4^{bp}
Dik wee	2.2 ± 0.3^{as}	0.8 ± 0.5^{bp}	1.1 ± 0.2^{cv}	0.6 ± 0.3^{bp}	9.6 ± 0.2^{dt}	1.1 ± 0.6^{bp}
Dahanala	6.3 ± 0.5^{at}	1.0 ± 0.4^{bp}	2.1 ± 0.4^{cqvw}	0.6 ± 0.3^{bp}	8.2 ± 0.5^{dpuv}	0.7 ± 0.1^{bp}
Unakola samba	5.8 ± 0.6^{at}	0.9 ± 0.3^{bp}	3.2 ± 0.7^{crtx}	0.5 ± 0.1^{bp}	7.7 ± 0.5^{dqu}	1.1 ± 0.3^{bp}
Hangimuththan	4.6 ± 0.3^{aqr}	0.9 ± 0.3^{bp}	2.7 ± 0.4^{csuwx}	0.9 ± 0.3^{bp}	9.1 ± 0.3^{drtv}	0.9 ± 0.2^{bp}

a-d in each row and p-x in each column indicate the significant difference at $p<0.05$; n=5

RS content of raw cooked varieties varied between 2-6% where *Dik wee* had the lowest and *Dahanala*and *Unakola samba*had the highest RS%. Raw polished cooked varieties had 1-3% RS content where *Dik wee* had the lowest and *Batapola el*and *Unakola samba*had the highest RS content. Increased ($p<0.05$) RS was observed in parboiled cooked varieties (6.5-10%) where *Batapola el* showed the lowest and *Dik wee* showed the highest RS%. RS content of all uncooked varieties were below 1.1% and significantly lower ($p<0.05$) than all cooked rice varieties and not significantly different to each other.RS contents of differently processed cooked rice varieties significantly ($p<0.05$) increased in the order of raw polished, raw and parboiled.

Cooking has significantly increased the RS content of all differently processed rice varieties compared to uncooked rice. This may be mainly due to the retrogradation of starch by gelatinization which destroys the the molecular order of starch, and the dispersed starch polymers reform as a semi-crystalline structure when cooled whereas in uncooked rice RS is found only as physically inaccessible starch due to structural encapsulation (Garcia Alonso *et al*. 1998). In parboiled cooked rice, due to the repeated heating and cooling the amorphous phase of the starch granule swells and the crystalline regions are even more disrupted. This higher disruption contributes to the higher RS formation in parboiled cooked rice (Mangala and Tharanathan 1999) (Sagum and Arcot 2000).

Conclusion

RS contents of cooked raw and raw polished varieties were significantly lower confirming the contribution made by retrograded starch to RS due to parboiling process. Removal of rice bran during the milling process removes fiber which contributes to the RS content.

Recommendation

Comparing the RS contents of differently processed traditional rice, parboiled rice can be recommended for individuals seeking to control blood glucose levels and obesity.

Acknowledgment

Financial assistance by University of Sri Jayewardenepura (Grant No. ASP/01/RE/MED/2016/51).

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