https://doi.org/10.29321/MAJ.10.A02480

Madras Agric. J 71. (5) 328–331 May 1984

INFLUENCE OF PROCESSING METHODS ON THE GEL LENGTH OF PARBOILED RICE

P. PILLAIYAR*

A rapid test to indicate the texture of parboiled rice without cooking has recently been developed. In this test, a gel is developed in rice flour by reacting it with standard alkali. The influence of parboiling methods on the gel length was studied. Different varieties of paddy was parboiled by single steaming, double steaming, warm soaking, hot soaking and pressure parboiling methods. After drying, milling and powdering the samples under identical conditions, the gel was developed. The EMC-S of the milled rice was also determined. The gel length was significantly influenced by the parboiling methods. Both the gel length and EMC-S values were significantly more for parboiled than for raw samples. Among parboiled lots, the samples prepared by single steaming had significantly a low value for both the gel length and EMC-S values and the pressure parboiled samples had significantly a high value. Other samples had intermediate values but showed an increase with the increase in heat treatment given during parboiling process.

Because of its higher milling recovery and greater nutritional status, parboiled rice is mostly preferred in countries like India, Bangladesh, Nepal and Sri Lanka. Parboiled rice has many other advantages like less susceptibility to infestation during storage, higher oil in bran with better storability, least disintegration during cooking, less solid loss in gruel, more swelling when cooked to the desired softness and easy digestibility with higher Protein Efficiency Ratio (Pillaiyar 1981). Different household and commercial methods of parboiling to cater to the needs of a variety of consumers exist. It had been indicated that the processing methods, by and large, influence the quality of parboiled rice (Mecham *et al.* 1961; Mohandoss and Pillaiyar, 1982); the degree of heat and its duration at any step of parboiling process influence the cooking and palatability characteristics. Many instrumental tests (the Extrusion test: Mohandoss and pillaiyar 1980; the pressing-device test; pillaiyar and Mohandoss, 1981, the dropping device test: Pillaiyar and Mohandoss, 1983) have been developed to indicate the texture of parboiled rices Recently, a rapid test to indicate the texture of parboiled rice without the need for cooking has been developed (Pillaiyar. 1984). This test involves the development of a gel by reacting the parboiled rice flour with standard alkali and measuring the gel length. The influence of parboiled rices produced by different methods on the gel length was studied and the results are indicated.

*Paddy Processing Research Centre, Tamil Nadu Agricultural University, Tiruvarur-610 001

MATERIAL AND METHODS

ADT 34, IR 34, IET 4786, CR 1009, TKM 9 and Ponni varieties of paddy were parboiled as follows: (1) Single steamed: SS (the paddy was soaked in water at room temperature for 72 hr, the water drained and the soaked paddy open steamed at O psig); (2) double steamed: DS (the paddy was initially open steamed at O psig and then soaked in water for 36 hr, water drained and then steamed again at O psig); (3) warm soaked; WS (raw paddy was added to water at 90°C stirred and kept overnight with a cover and open steamed the next day morning; (4) hot soaked: HS (paddy was soaked at 65°C for 4 hr and then open steamed at O psig-CFTRI, 1960); (5) pressure parboiled: PP (paddy was open steamed for 10 min at O psig and then soaked by immersing in water for 30 min. After draining water, the paddy was autoclaved at 5 psig for 20 min followed by 25 psig for 10 min). All the samples were shade dried, dehulled in a Satake grain testing mill and polished in a McGill miller No. 3 to 6± O. 1% degree of milling. Representative samples of milled raw and parboiled rice were powdered to pass through 50-mesh screen and this flour was used or developing the gel

One hundred mg of the flour was taken in a small test tube 7. O X 1. 5 cm) 4 ml of 1.25% (by titration) KOH added, stoppered with rubber cork, thoroughly mixed by hand shaking for 5 min followed by centrifuging for 3 min at 1000 rpm and the gel length measured (Pillaiyar, 1984). As the EMC-S (equilibrated moisture content upon soaking in water at room temperature for 23h) of parboiled rice was positively correlated with the parboiling conditions it was also determined.

RESULTS AND DISCUSSION

The parboiling methods, varieties and their interactions significantly influenced both the gel length and the EMC-S values (Table 1). The gel length and EMC-S of parboiled samples were significantly more than that for raw rice and among parboiled rices the gel length and the EMC-S values followed a set pattern i.e., increasing with the severity of parboiling; the influence of SS being the least and the PP the most (Table 2). The gel length positively correlated with he EMC-S values ($r = 0.748^{**}$). The temperature of parboiling and the tenderness of cooked parboiled rice correlated negatively, indicating that more severe the heat treatment during parboiling. the poorer would be the palatability. The tenderness of PP sample as determined by the pressing device (Pillaiyar and Mohandoss, 1981) was poor when compared to other samples. Among other samples the tenderness was in the order of increase as HS < WS < DS. The dropping device method also down graded the PP sample for its tenderness (Pillaiyar and Mohandoss, 1983). In parboiled rice, the tenderness (hard or soft) is the deciding factor for its palatability. The gel length of parboiled rices positively correlated with the absolute cooking time and cohesiveness and negatively with the tenderness (Pillaiyar, 1984). Based on the EMC-S and W' 98°: W' 60° values, the quality of parboiled rices can be graded as SS > DS > HS > PP; the last one exhibiting extreme change in

Table 1 Influence of parboiling methods and varieties on the gel length and EMC-S values

Source	Gel length			EMC-S		
	S.E.D.	C.D. (P=0.05)	Sig	S.E.D.	C.D. P=0.05)	Sig.
Methods of Parboiling (M)	0.04	0.08	**	0.19	0.40	**
Variety (V)	0.04	0.08	**	0.19	0.40	**
M X V	0.10	0.21	**	0 48	0.98	**

** Significant at 1 % level

Table 2. Mean values of gel length and EMC-S of raw parboiled rices produced by different methods

Samples	Gel length (cm)	EMC-S (% w.b.)
Raw	0.84	28.8
SS	1.42	43.3
DS	1.57	46.1
WS	1.61	48.4
HS	1.74	50 7
PP	2.32	54.4

Table 3, Mean values of gel length and EMC-S for different varieties

Variety	Gel length (cm)	EMC-S (% w, b.)
CR 1009	1.33	41.6
Ponni	1.45	42 2
IET 4786	1.65	41.8
ADT 34	1.65	46.0
TKM 9	1 51	49.5
IR 34	1.91	50.7

quality (Mohandoss and Pillaiyar, 1982) probably because of its complete gelatinization. Steaming of soaked paddy for 60 min at 0 psig resulted in only 80% gelatinization whereas gelatinization was complete in 20 min at 10 psig (Priestley, 1976). Parboiling need not be so severe as in PP to reduce milling breakage as it had been established that whenever drying was in shade or under appropriate conditions, milling breakage after parboiling had been very low or negligible irrespective of its incidence in the original raw paddy (Bhattacharya and Subba Rao, 1966). Milling breakage was found to be negligible even in the samples parboiled at 80° or 90°C It was indicated that if the gel length of any parboiled rice is more than twice

of that of the corresponding raw rice, the texture of that rice would be poor (Pillaiyar, 1984). As the gel length of HS (1.74 Cm) and PP (2.32 Cm) was more than twice of the corresponding raw rice (0.84 cm) the texture of the cooked HS and PP samples would be poor. The cooked parboiled rices of SS, DS and HS were moderately tender to tender and well separated and on the other hand, the texture of PP cooked rices was tough and well separated (Mohandoss and Pillaiyar, 1982). Such hardness in the PP cooked rices may be related to the extreme apparent starch solubilization during parboiling (Priestley, 1976) or to the extent of amylose retrogradation after parboiling (Ali and Bhattacharya, 1976). A highly significant negative correlation was observed between the temperature of parboiling and soluble amylose present in the excess cook water.

While pooling the test results for all the varieties, it was fount fount the gel length of raw sample was significantly low and that of PP sample significantly more. Same was the case with the EMC-S values. The gel length of HS of different varieties was on par with WS and DS or SS except in case of Ponnl where it was significantly more than WS, DS and SS. CR 1009 had significantly low values for gel length and EMC-S and IR 34 samples high values, other varieties having intermediate values (Table 3) Varietal response to parboiling had been indicated (Alary *et al*; 1977; Mohandoss Pillaiyar, 1982).

REFERENCES

ALARY, R., B. LAIGNELET and P. FEILLET. 1977. Effects of amylose content on some characteristics of parboiled rice, J. Agric. Food Chem., 25: 261-64

ALI, S.Z. and K.R. BHATTACHARYA, 1976. Starch retrogradation and starch damage in parboiled rice and flaked rice. Starke *28*: 233-40

BHATTACHARYA, K.R. and P.V. SUBBARAO, 1966. Processing conditions and milling yield in parboiling of rice, J. Agr. Fd Chem. *14*: 473-75

CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE, 1960. *Parboiling of paddy*, Circ No. 7 (Revised), Central Food Technological Research Institute, Mysore, India.

MECHAM, D.K., E.D. KESTER and J.W PENCE. 1961. Parboiling characteristics of California medium grain rice, Fd Technol. (Chicago) 15: 475-79.

MOHANDOSS, R. and P. PILLAIYAR, 1980. An extrusion test for determining the palatability of parboiled rices. J. Fd Sci. Technol. 17 (5): 244-46

MOHANDOSS, R. and P. PILLAIYAR, 1982. Influence of parboiling and drying methods on the quality of parboiled rices. Madras agric J 69 (3): 185-92

PILLAIYAR, P 1981. Production of quality parboiled rice, Malays. agric. J 53 (2): 97-105.

PILLAIYAR, P. 1984. A rapid test to indicate the texture of parboiled rices without cooking, J. Texture Studies, 15 (3):

PILLAIYAR, P. and R. MOHANDOSS, 1981. A pressing device to measure the texture of cooked rice, J.Texture Studies 12 (4): 473-81

PILLAIYAR, P. and R. MOHANDOSS, 1983. A simple dropping methods for determining the texture in parboiled rices, J. Fd Sci. Technol. 20 (1): 34-36

PRIESTLEY, R.J. 1976. Studies on parboiled rice 2: Quantitative study of the effects of steaming on various properties of parboiled rice, Fd Chem. 1: 139-48.