

## EFFECT OF WATER LEVELS ON THE MICROFLORA AND SOAKING LOSS IN PARBOILING OF PADDY

N.RAMALINGAM and S.ANTHONI RAJ

Department of Microbiology  
Agricultural College and Research Institute  
Tamil Nadu Agricultural University  
Madurai 625 104

### ABSTRACT

Bacterial and fungal population in both paddy and soak water increased during soaking of paddy for parboiling. Increase in the volume of water decreased the microbial population. However, using twice the volume of water over paddy used for soaking enhanced the soaking loss. The total sugars, reducing sugars and amino nitrogen present in paddy diffused into soak water during soaking. Total phenolic contents of paddy was increased during soaking and was the highest in 1:1 (w/v) paddy : water ratio. Biochemical oxygen demand (BOD), chemical oxygen demand (COD) decreased in the effluent when paddy was soaked in higher water levels.

**KEY WORDS :** Paddy, Paraboiling, Water, Soaking, Microflora

Parboiling is the common method of processing paddy in South India. In parboiling, paddy is steeped in water to hydrate the grains, steamed and dried before milling. Cold soaking is one of the ancient methods followed in conventional rice mills, wherein, raw paddy is soaked in cold water continuously for three days. During soaking, water soluble constituents from paddy diffuse into soak water, encouraging microbial activity. Paddy grains carry microflora and the water used for soaking is also not sterile and hence the microbes proliferate leading to characteristic off odour. Draining the soak water in open land, sewers or irrigation channels become an environmental concern. Since the present practice in rice mills is to allow water to stand 5-10 cm above paddy and there is no information on the influence of quantum of water used for soaking on the microflora, leachate loss, off odour and the effluents discharged. Hence, the present study was taken up.

### MATERIALS AND METHODS

Two kg lots of freshly harvested IR 50 paddy were soaked for 72 h separately with 2, 3 and 4 l of cold water to give a paddy water ratio of 1:1.1:1.5 and 1:2 (w/v). Paddy and water samples withdrawn initially after 24, 48 and 72 h were serially diluted in quarter strength Ringer's solution (Hobbs, 1982) and 1 ml aliquots were plated on nutrient and rose bengal agar to enumerate the microflora. The biochemical constituents of the soak water were determined after filtration and centrifugation at 5000g for 10 min. These constituents were also

determined in the alcohol extract of paddy (Mahadevan and Sridhar, 1985).

The sugars, phenolic compounds and amino nitrogen were estimated following the routine methods.

In amylase activity in paddy was assayed in the buffer extract from paddy (Pestano and Castillo, 1985). The amylase activity was expressed as units (mg of starch hydrolysed  $\text{mg}^{-1}$  protein  $\text{min}^{-1}$ ). The proteins in the enzyme extract were estimated by the dye binding assay (Bradford, 1976). The dry matter loss in paddy was determined by gravimetric analysis and expressed as percentage. The organic carbon content of the soak water was determined by the dichromate oxidation method of Walkley and Black (Piper, 1950). The biochemical and chemical oxygen demands of the soak water were determined by standard methods.

### RESULTS AND DISCUSSION

The total aerobic bacteria and fungi (Fig. 1) in paddy declined immediately after soaking. With the progress of soaking, they increased in paddy and water but the extent varied with the water levels. Paddy grains carry a mixed microflora harboured during crop growth and at harvest and the water used for soaking is also not devoid of any organisms and hence they are bound to multiply utilising the diffusates from paddy. However, this multiplication may be delayed or the intensity minimised by enhancing the water levels. Narmani and Anthoni Raj (1988) reported a

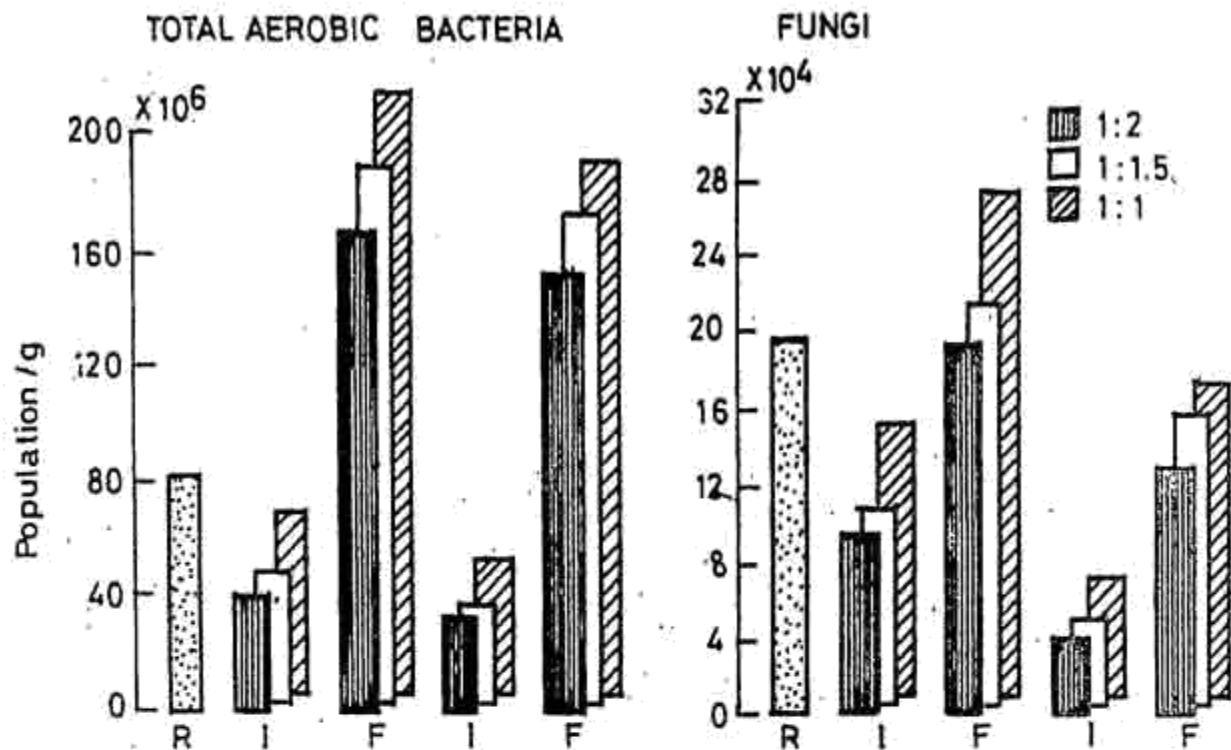


Fig.1. Total aerobic bacteria and fungi in paddy in cold soaking of paddy with different water levels (R-Raw paddy; I - Initial; F-Final)

Table I. Changes in sugars, amino nitrogen, phenols, amylase activity and dry matter loss during soaking of paddy with different water levels

Particulars	Total sugars* (mg/g)	Reducing sugars* (mg/g)	Amino nitrogen** (mg/g)	Total phenols@ (mg/g)	Amylase***	Dry matter loss (%)
Raw paddy	3.695	0.793	1.272	0.468	0.06	-
Paddy : water 1:1 (w/v)						
Soaked paddy 0 h	3.997	0.770	1.130	0.362	0.05	0.39
24 h	2.840	0.825	1.510	0.411	1.28	1.12
48 h	2.789	1.599	1.922	0.472	1.39	1.49
72 h	2.509	1.863	2.419	0.542	0.51	2.38
Steamed paddy	1.910	1.805	1.435	0.458	0.07	2.58
Paddy : water 1:1.5 (w/v)						
Soaked paddy 0 h	3.972	0.765	1.135	0.362	0.05	0.39
24 h	2.558	0.828	1.285	0.416	1.27	1.23
48 h	2.508	1.634	1.443	0.449	1.32	1.86
72 h	2.406	1.880	2.215	0.505	0.50	2.54
Steamed paddy						
Paddy : water 1:2 (w/v)						
Soaked paddy 0 h	3.985	0.769	1.138	0.362	0.06	0.39
24 h	2.962	0.835	1.116	0.376	1.28	1.37
48 h	2.643	1.661	1.315	0.425	1.30	1.98
72 h	2.385	1.921	2.108	0.495	0.51	2.73
Steamed paddy	1.982	1.895	1.615	0.442	0.07	2.92

\*\*\* m. of starch h drol sed/mg protein/min @ mg of catechol/g of paddy

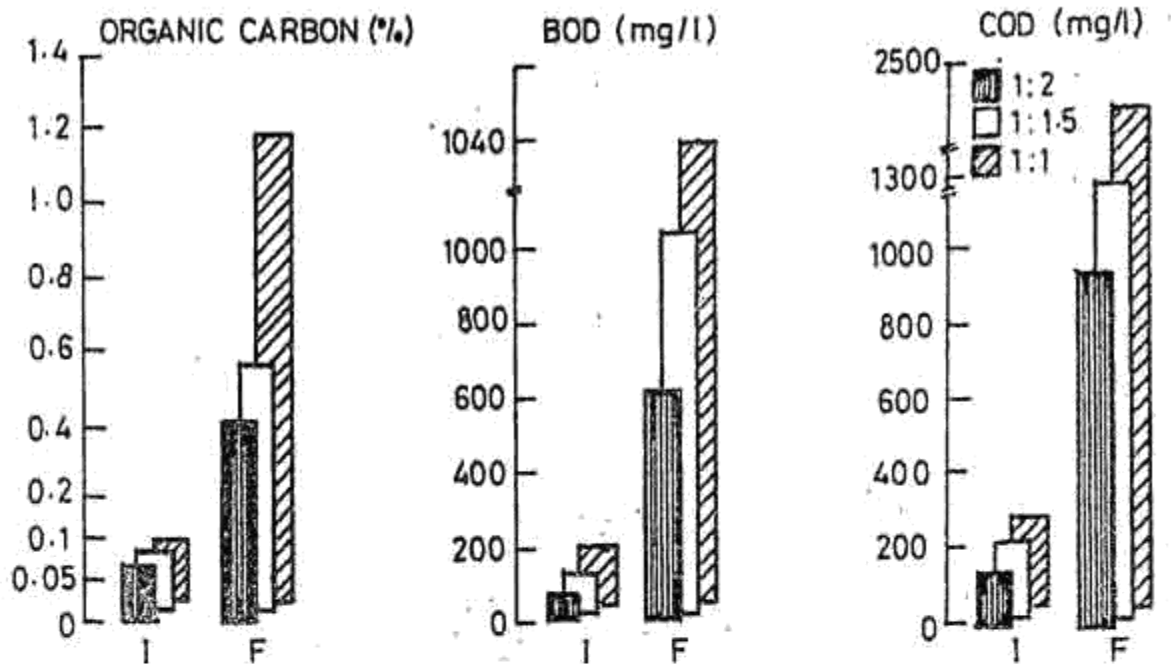


Fig.2. Organic carbon content, biochemical and chemical oxygen demands in soak water from cold soaking of paddy with different levels of water (I - Initial; F - Final)

higher microbial activity during cold soaking of paddy. In the present study an increased fungal activity was observed, although Desikachar *et al.*, (1955) reported a decrease in filamentous fungi during soaking.

The reducing and total sugars in paddy decreased slightly just upon soaking. The reducing sugars increased in paddy and soak water with further soaking (Fig. 2). At higher water levels although an increase was observed in paddy a reverse trend was observed in soak water. The total sugars decreased in paddy with the period of soaking and the decrease was relatively higher in paddy water ratio of 1:1.5 and 1:2 (W.V.) However, the total sugars accumulated in soak water and this accumulation was lesser at these paddy : water ratios. The content per unit volume of soak water higher in paddy water ratio of 1:1 while its content when the entire soak water was considered was higher in 1:1.5 and 1:2 indicating a larger leachate loss at higher water levels. Further it has to be noted that what was observed in soak water was left behind after microbial utilization. An increase in

into soak water was already reported (Anthoni Raj and Singaravadivel, 1980). With the increased microbial activity, the diffusion from the grains and utilisation by the microbes was also greater.

A decrease in the amino nitrogen content after soaking was observed followed by an increase in paddy. The initial decrease might be due to its diffusion into soak water from the amino acids of grain while the subsequent increase might be due to (1) proteolysis by microbes or (ii) synthesis by microbes. Anthoni Raj and Singaravadivel (1980) reported an increase in amino acids in paddy and soak water during soaking. Gariboldi (1974) reported solubilization of albumins and their breakdown to amino acids during soaking. At lower paddy water ratios, the increased microbial activity coupled with a higher level of amino acids per unit volume of soak water might lead to fermentation of amino acids yielding more of volatile compounds and amines that might impart the intense off-odour.

The total phenolic compounds increased in grains during soaking and the increase in paddy

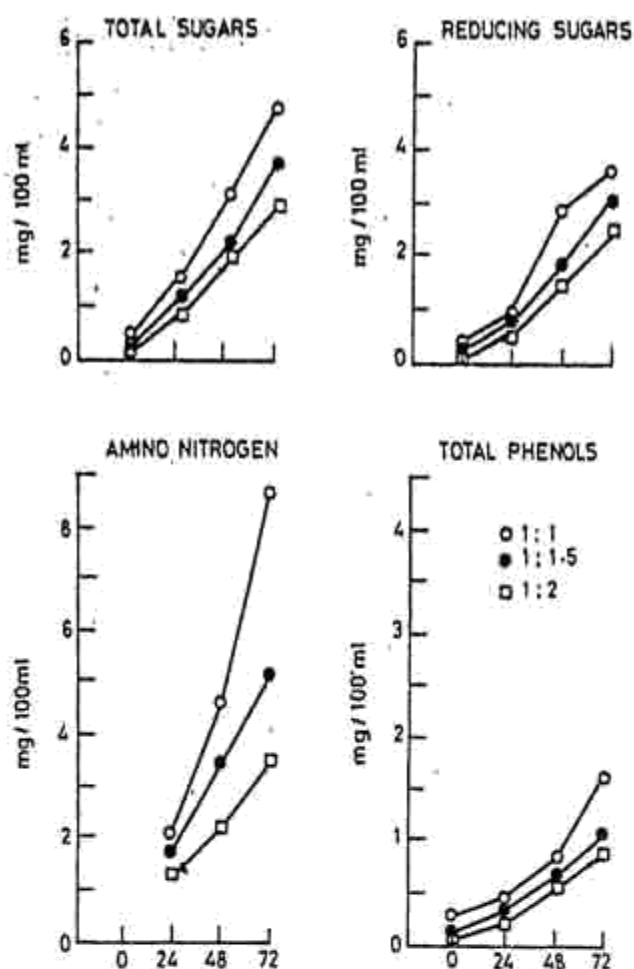


Fig. 3. Changes in sugars amino nitrogen and total phenols in the soak water during cold soaking of paddy with different levels of water

employed. The colour of the soak water gets diluted at higher water levels and hence there is no intense yellow colour as observed when low volume of water used. Singaravadivel and Anthoni Raj (1979) reported an increase in phenolic compounds in paddy and their diffusion into soak water. This might arise out of (i) synthesis from sugars (ii) conversion from aromatic amino acids and (iii) the release from husk and lignin. At higher water levels the total phenol content in paddy increased over the period of soaking which was relatively lesser than in paddy soaked with low volume of water. Although the total phenol content per unit volume of soak water in paddy: water ratio of 1:2 and 1:1.5 was lesser than that of 1:1 owing to the dilution effect the total quantity leached out was higher for the whole volume. The leaching of phenols is of immense value as it imparts a colour to milled rice upon oxidation in steaming.

Steaming resulted in a decrease in the sugars, amino acids and phenols and the decrease was

(Table 1). The reduction in reducing sugars and amino nitrogen upon steaming might be due to millard type of browning reaction contributing to the characteristic amber colour of parboiled rice. As this reduction was relatively lesser in paddy soaked in paddy water ratio of 1:2 the browning of kernels was also comparatively less. The dry matter loss increased with the increase in water levels. After 72 h soaking, the loss was 2.38, 2.54 and 2.73 per cent respectively in paddy water ratios of 1:1, 1:1.5 and 1:2 (w/v). The increased loss at higher water levels might be due to higher leaching, enhanced amylase activity, and sprouting of grains under submergence. In paddy water ratio of 1:2, sprouting of grains at the top layer was also noticed.

Increasing the level of water for soaking reduced the organic carbon content in the effluent and hence reduced the biochemical (BOD) and chemical oxygen demand (Fig.3). After 72 h of soaking, the organic carbon content of soak water from paddy : water ratio of 1:1 was 1:2 per cent compared to 0.57 and 0.42 per cent respectively in 1:1.5 and 1:2. The BOD at the commencement of soaking was 207, 135 and 65 mg l<sup>-1</sup> respectively at 1:1, 1:1.5 and 1:2 paddy water ratios and increased to 1363, 1038 and 632 mg l<sup>-1</sup> respectively after 72 h. The BOD also exhibited a similar increase. It is evident from the present study that the organic carbon content, BOD and COD of soak water shall be minimised by the use of higher volume of water so that the environmental pollution due to the discharged effluent and its off odour will be minimum.

Thus use of paddy water of 1:2 might not only minimise the colour of the effluent discharged, organic carbon content, BOD, COD and the intensity off odour but also the amber colour of the parboiled milled rice. But enhanced water ratio increased the dry matter loss and the decreased the outturn of rice.

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## SEED COAT SCLEREIDS IN CERTAIN PULSES

A.KALAMANI

Centre for Plant Molecular Biology and Biotechnology  
Tamil Nadu Agricultural University  
Coimbatore 641 003

### Abstract

Sclereids present in the seed coats of various members belonging to the family *Leguminosae* have been investigated. With microtome sections and macerations of the seed coats, the type of sclereids and their arrangement have been studied. Macrosclereids and osteosclereids were noticed in all cases. These sclereids were arranged in compact manner in one or two layers below the epidermis of seed coat.

KEY WORDS : Sclereids, Seed Coat, Legumes

One of the most characteristic features of the leguminous seed is the presence of one or two layers of sclereids in the testa. The hardness of the seed coat is due to the presence of sclereids. The seed coat sclereids occur in a single or double layer especially as palisade layer. The structural features of seed coat of papilionaceous seed was well documented by Corner (1951). These studies dealt with the surface characters of seeds and the nature of hilum as well as the sclereids in different layers of the seed coat. Chowdhury and Buth (1970) made statistical analysis of height of palisade sclereids in the seed coats of certain Papilionaceae and they prepared a key for the identification of Indian pulses with the aid of seed structure. The distribution pattern, the nature and structure of sclereids of different layers if present will have a great taxonomic value. The aim of present investigation is to find out the nature, type, structure, frequency and pattern of distribution of sclereids in certain members of pulses.

### MATERIALS AND METHODS

The seed coats of the following were investigated in the present study. *Cajanus cajan* L., Millsp.(QUS 7), *Cicer arietinum* L. (CO 1), *Cyamopsis tetragonolobus* L. (CO.1), *Dolichos biflorus* L.(CO.1), *Lab-lab* L.(typicus) *Vigna mungo* (Linn) Hepper (ADT 5), *Vigna radiata* (L.) (CO.1), *Pisum sativum* L. var. arvense, *Sesbania grandiflora* Pers., *Trigonella foenumgraecum* L. Nagauri and *Vigna unguiculata* L. Walp (CO 4). For studying the distribution pattern of sclereids, microtome slides were prepared for all the materials mentioned above. Mature seeds were immersed in water for swelling. The seed coats were then removed and fixed in F.A.A. Dehydration in isopropylalcohol was followed by embedding in paraffin wax. Sections were cut at 15-25  $\mu$  thickness and were stained with safranin-fast green (Johansen, 1940). In addition to microtome slides, observations on macerated