Short Communication Oryza Vol. 46. No.2, 2009 (167-170)

Effect of natural aging on fatty acid profile of Pusa Basmati rice

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ABSTRACT

The effect of natural aging on fatty acids profile in aromatic Pusa Basmati rice was studied. Lipid content and fatty acid profile of the samples were measured at an interval of 30 days. The total lipid content of the samples during the period of six months of natural aging decreased by 2.8% from that of freshly harvested samples. The major fatty acids of rice lipids were oleic acid (18:1), linoleic acid (18:2), and palmitic acid (16:0), myristic acid (14:0), stearic acid (18:0) and linolenic acid (18:3) were the other fatty acids which were also identified and quantified. The results indicated that the fatty acid profiles of rice lipids changed during aging of aromatic rice. The desirable ratio of oleic acid to linoleic acid for all the samples remained within the safe limits.

Key words: *Aromatic rice, natural aging, fatty acids*

The rice obtained from the freshly harvested paddy is less suitable both for processing and culinary utilization, whereas adequate aging brings about the desirable properties for the purpose. (Perez and Juliano, 1981). The stored paddy gets influenced by the initial conditions of the grain, storage period and environmental conditions which result in quality changes. Aleurone layer contains valuable components like oil, protein and vitamins along with enzymes (Barber and Barber, 1980). The storage environmental conditions may activate the enzymes and microorganisms to hydrolyse the bran oil to produce long chain free fatty acids that are responsible for off flavors (Saunders and Heltved, 1985). Thus it becomes essential to maintain the desirable ratio of saturated and unsaturated free fatty acids within the safe limits. It was hypothesized that the rice lipids are liable to oxidation and/or hydrolysis during aging and may thereby contribute to the flavour characteristics of the aged rice. These changes in rice may influence the functional qualities of rice. It may cause undesirable effects on the end product, depending upon aging conditions. The present investigation is an effort to study the effect of aging on fatty acid profile in Pusa Basmati rice grown extensively in northern India.

The investigation was undertaken at the GB Pant University of Agriculture and Technology, Pantnagar. After collection of the freshly harvested paddy the foreign materials such as dust, dirt, chaff etc. were removed using an air screen cleaner. The moisture content of the paddy sample was determined using air oven method. The lots were dried under shade till the moisture content of the paddy came down to 13±0.5%. The samples were kept for tempering for 6-8 hours. The tempered samples were stored in air tight double layered polyethylene bags to avoid any moisture exchange. These samples of dried paddy of Pusa Basmati were stored in gunny bags of 1kg capacity under ambient conditions in a room. The samples were subjected to aging for a period of six months from December to April under natural environmental conditions. A representative sample of 150 g was drawn from each gunny pack at an interval of one month for quality analysis. The samples were dehusked using 'Satake' laboratory sheller (Model THW-35, Japan). The brown rice obtained was ground to 60 mesh. Lipid content was measured using a rapid solvent extractor (Soxtec System Extraction Unit, HT 1043). The oil so extracted was subjected to esterification (Luddy *et al.*, 1968). The methyl esters obtained from the lipids of the treated rice samples were analysed on a 5890 Series II Gas Chromatograph, equipped with a flame ionization detector for fatty acid composition. The identification of the specific fatty acid esters was made on the basis of retention time of their standard derivatives.

Quantitative estimation of the fatty acid composition was done by the peak area method.

An examination of the ambient temperature and relative humidity data revealed that there was a fluctuation in both the values round the clock throughout the experimental period. However, the average values were favorable of view as far as storage of paddy was concerned.

The total lipid content of brown rice of Pusa Basmati ranged from 1.38% to 1.42% (Table 1). It was observed that the total lipid of the samples during six months of natural aging decreased by 2.8% from that of freshly harvested samples. It is evident that the major fatty acids of rice lipids were oleic acid (18:1), linoleic acid (18:2), and palmitic acid (16:0) (Table 1) coinciding with the findings of Hemavathy and Prabhakar (1987). Myristic acid (14:0), stearic acid (18:0) and linolenic acid (18:3) were the other fatty acids which were also identified and quantified. The residence time for myrirtic acid, palmitic acid, stearic acid, oleic acid, linoleic acid and linolenic acid was 5.247 min, 8.259, 14.151, 15.057 17.156 w 20.645 min, respectively. Palmitic acid was considerably higher as compared to myristic and stearic acid among saturated fatty acids. Among unsaturated fatty acids the oleic acid was maximum followed by linoleic and linolenic acid. Palmitic acid values were low as compared to oleic and linoleic acid. It is having low linolenic acid content which may be one of the main factors to maintain the keeping quality of oil. High linolenic acid (18:3) is unsuitable for food products due to its instability and reversion of flavor associated with auto oxidation as suggested by Smouse (1978). The chromatograms depicting the fatty acid (FA) profile in rice of Pusa Basmati for fresh and aged rice grains are presented in (Fig. 1 to 7). During the natural aging period of six months the total saturated fatty acids increased continuously from 23.89 to 28.43% whereas the unsaturated fatty acids decreased from 76.11 to 71.57% (Table 1). Aging of paddy up to six months resulted in gradual decrease in levels of oleic acid (42.99 to 41.64%) and linoleic acids (31.67 to 29.93%) with increase in palmitic acid (20.94 to 24.10%). These findings are in conformity with the reports of Shin and Godber (1996) in brown rice during storage up to 52 weeks. The trend of FA profile in brown rice when stored up to 12 months after drying under different conditions (Dhaliwal *et al.*, 1999) also tallies well with the present findings. Less amount of linolenic acid (1.36%) was found in freshly harvested rice, whereas towards the end of storage (6 months) complete lack of linolenic acid was observed. Either it was absent or could not be detected.

Medical science reports (Grundy; 1997) that some dietary saturated fatty acids raise serum cholesterol concentrations. These include palmitic acid, myristic acid, lauric acid and stearic acid. These cholesterol raising fatty acids should be reduced in the diet as much as is practical to effect a substantial lowering of cholesterol concentration. It has become conventional to use monounsaturated fatty acids such as oleic acid as the base line or neutral fatty acid. Oleic acid neither raises nor lowers total cholesterol concentration. Among the polyunsaturated fatty acid category linoleic acid is the predominant fatty acid. Past investigation suggests that linoleic acid lowers total cholesterol concentration relative to oleic acid. In contrast, a high intake of polyunsaturated fatty acid is the potential source of harmful effects. Thus the ratio

Table 1. Effect of natural aging on lipid content (%) and fatty acid profile (%) of Pusa Basmati

Aging period, days	Lipid content	Myristic acid	Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid	Total saturated	Total unsaturated	Oleic acidto linoleic acid	Total saturated to linoleic
0	1.42	0.5	20.94	2.45	42.99	31.67	1.45	23.89	76.11	1.36	0.76
30	1.42	0.6	22.30	2.73	42.75	30.52	1.10	25.63	74.34	1.40	0.84
60	1.42	0.9	22.60	3.08	42.32	30.10	1.00	26.58	73.42	1.41	0.88
90	1.40	1.43	22.65	2.56	42.27	30.19	0.90	26.64	73.36	1.40	0.88
120	1.38	1.65	23.39	2.18	41.98	30.00	0.80	27.22	72.78	1.40	0.91
150	1.38	1.77	23.85	2.78	41.70	29.90	-	28.40	71.60	1.39	0.95
180	1.38	1.86	24.10	2.47	41.64	29.93	-	28.43	71.57	1.39	0.95

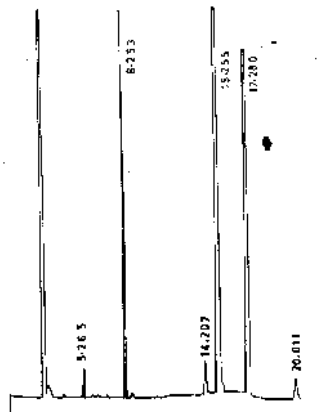

Fig. 1. Fresh paddy

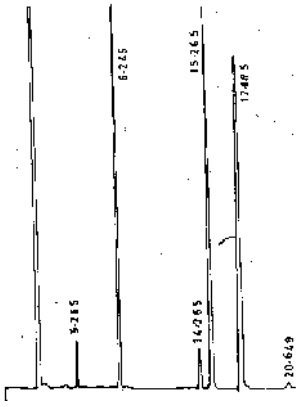

Fig. 2. FA profile (30 days)

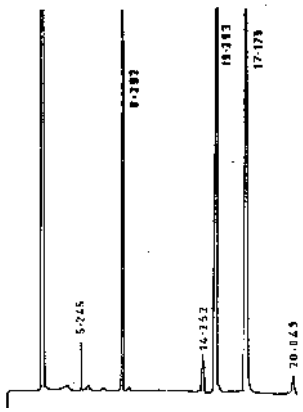

Fig. 3. FA profile of (60 days)

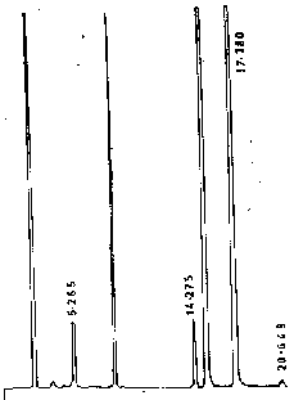

Fig. 4. FA profile (90 days)

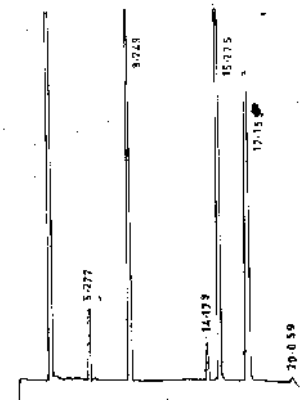

Fig. 5. FA profile (120 days)

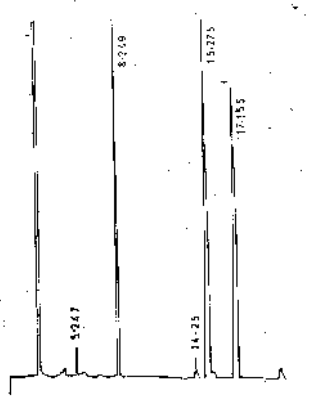

Fig. 6. FA profile (150 days)

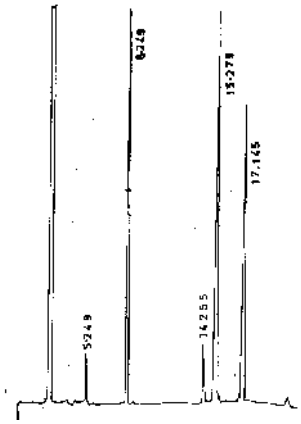

Fig. 7. FA profile (180 days)

of cholesterol raising fatty acids to polyunsaturated fatty acid should be about one–to-one. However, Grundy (1997) was of the opinion that the most desirable ratio of oleic to linoleic acid lies between 1:1 and 3:1. In the preent investigation that the total saturated fatty acid varies from 23 to 28% and linoleic acid (major poly unsaturated) ranges from 29 to 30% (Table 1). The proportion of these two components varies from 1 to 1.3. Further more, a noticeable amount of oleic acid was present in the sample to neutralize the effect of additional saturated fatty acids. The oleic to linoleic acid ratios of all the samples are presented in Fig.8. As suggested by Grundy (1997) the lower and upper limits of this ratio are 1:1 to 3:1, respectively. This ratio for

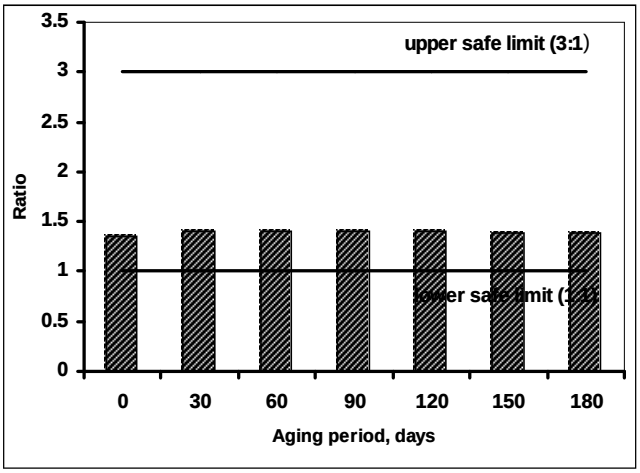

Fig. 8. Effect of natural aging on oleic and linoleic acid ratio

freshly harvested sample is 1.36. During aging it has gone up to a maximum of 1.41 which is within the safe limits.

It is quite evident from the present study that the fatty acid profile of rice lipids changed during aging of basmati rice. The differential behaviour may be due to varied interactions between rice lipids and other rice constituents. However, the desirable ratio of oleic acid to linoleic acid for all the samples remained within the safe limits.

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