



Ageing: As Miracle for Rice to Improve Quality

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Rice is seed of grass species namely *Oryza Sativa* or *Oryza glaberrima*. It is the most widely consumed staple food for large part of world's population, especially in Asian continent. About 90 % production of rice is done in south Asian countries so it is accounted as Asian crop. This cereal grain is rich in carbohydrates, oil, vitamins, minerals which satiate human needs. Rice being prominent crop of India, it is the staple food of most of the people of the country. This crop provides the livelihood for millions of rural households and plays significant role in the country's dream of food security, hence in the Indian context the term "rice is life" is most appropriate (Mahajan *et al.*, 2018). India occupies an important position both in area and production of rice. India produces 135.5 million MT of rice in year 2022-2023. India is the second largest producer of rice in world with largest exporter of rice. Generally, rice is grown in south Asian countries because of high rainfall, soil as well as suitable climatic conditions for rice production. Indian rice has high demand from Arabic and European countries because of its characteristics like appreciable taste, aroma and texture. This article embodies the mechanism of ageing of rice as well as its types.

Mechanism of ageing

Ageing is the typical process between harvest and consumption. Rice during storage undergoes many physicochemical changes, which in turn affect the cooking quality. Interestingly, stored rice is preferred over raw rice, owing to an improved flavor perceived. Therefore, ageing of rice is one of the important steps in post-harvest processing. Effectiveness of the ageing process also largely depends on variety of rice, storage environments, and treatments. During ageing of rice amylose content plays important role which is considered as the primary factor determining rice cooking quality. Higher availability of amylose in the accelerated aged rice is expected to contribute to the cooking quality and ease of processing since higher amylose content reduces stickiness and increases the firmness of the cooked grains (Juliano, 1971).

A mechanism of ageing involving lipids and proteins was proposed by Moritaka and Yasumatsu (1972). The proposal envisaged the formation of a complex between lipids form free fatty acids with with amylose, carbonyl compounds and hydroperoxides, which can accelerate protein oxidation and con-densation plus accumulation of volatile carbonyl compounds. Protein oxidation (formation of di-sulfide linkages from sulphhydryl groups), together with an increase in the strength of micelle binding of starch can inhibit swelling of starch granules and affects cooked rice texture. Mod *et al.*, (1983) proposed that oxidation of ferulate esters of hemicellulose would contribute to cross-linking and increased strength of cell walls during storage. The reduction in stickiness is attributed to the fact that higher amylose content leads to significantly lower leaching of total solids from the rice during

cooking (Li *et. al.*, 2017). Amylose content is also reported to be directly related to water absorption, volume expansion, fluffiness and the ability of cooked grains to separate.

There are several advantages of the ageing process which includes higher head yield; it improves pasting property of rice. Ageing results in firmer texture and less sticky rice due to enhanced volume expansion and water uptake during cooking. Aging of rice is an intricate and complex phenomenon that is perceived to begin before harvest and lasts until consumption. During ageing, significant changes occur in the physicochemical, sensory, cooking and pasting properties of rice. Most changes are time and temperature dependent and their effects on grain quality are irreversible; mostly being beneficial. Aged rice has better commercial value and higher consumer preference in terms of cooked rice texture, flavor and associated parameters.

Types of ageing

1. **Natural ageing:** Natural ageing of rice is a simple process that occurs during storage of rice. In natural ageing processed rice was not subjected to any artificial controlled conditions like different time/temperature combinations and various relative humidity. In natural ageing rice is simply kept in open storages at room temperature and it takes minimum of 3 to 4 months for changes in properties to occur. During storage deterioration of the quality of rice can also be caused owing to risks from insect infestation, rodents attack and squandering of grains by birds/animals. Proper safe storage conditions as well as monitoring therefore are the prerequisites for safe storage of rice, which at times could be quite cumbersome.
2. **Artificial/ accelerating ageing:** Accelerated ageing is an artificial process which stimulates rice to undergo physical, physicochemical and biological changes within a short duration of time. This technique is used to improve textural, pasting, optical, thermal and cooking properties within a short period of time. There were many methods adapted for accelerating ageing which includes conditioning & drying, drying & tempering, moisture–temperature combinations, hydrothermal treatment, drying cum curing, thermal treatment, microwave treatment, heat treatment by radio frequency, etc. The following table summarizes the difference between natural and accelerated ageing process.

Natural Ageing	Accelerated ageing
<ul style="list-style-type: none"> ▪ It is long duration process required minimum 3 to 4 months ▪ It requires large space, high operational and maintaining cost and it is batch process ▪ During natural ageing danger of infection by microorganisms is high ▪ It is useful for domestic purpose 	<ul style="list-style-type: none"> ▪ It is short duration post-harvest process only take few minutes to few days ▪ It has small space requirement, low maintenance cost and continues process ▪ No danger of infection ▪ Maintain the continues supply of aged rice in market ▪ It is useful in large capacity industries

Methods of ageing

1. **Natural ageing methods:** There various natural methods of ageing are available. During natural ageing freshly harvested paddy stored for 3 to 4 months in ambient storage conditions (26 to 30 °C temperature & 70 to 80% RH). In some methods freshly harvested rice kept in different packaging material like polyethylene (HDPE), light density polyethylene (LDPE) for 5 months at temperature ranges from 10 to 35 °C. Aging is known to be a complex phenomenon. Long storage period, larger space requirement, cost of infrastructure, microbial contamination and susceptibility to infestation makes natural ageing economically unviable and cumbersome. So, in order to overcome these problems

of natural aging, accelerated ageing is being considered as an alternative method since it requires less time and space.

1. **Accelerating ageing methods:** Apart from natural methods of rice ageing, it can also be achieved by artificial means. Because it has many advantages over natural ageing and beneficial for commercial as well as industrial level. Some of the accelerating ageing methods are given in following table:

Table: Methods of accelerated ageing of rice.

S. No	Method	Treatment	Reference
1	Microwave heating	Rice grains are exposed with 700 W microwave energy for 60 s	Nayak et al., 2019
2	Steaming	Paddy is steamed in autoclave at pressure 0.5 to 1.5 kg/cm ² for 10 to 15 min	Yeragopu et al., 2019
3	Thermal treatment	Fresh milled rice is maintaining at temperature 42.6 °C for 10 days at 70 & RH	Rayguru et al., 2011
4	Thermal treatment	Freshly harvested rice is heated at 130 to 150 °C for 90 to 120 min at 28 to 33 % moisture content	Soponronnarit et al., 2007
5	Thermal treatment	Rice is heated from temperature 80 to 120 °C for 3 to 15 hours	Rosniyana et al., 2004
6	Steaming	Paddy is steamed in autoclave for 30 min	Gujral et al., 2003
7	Drying cum curing	Rice is heated in between temperature of 95 to 155 °C for 1 to 1.5 min and tempering for 1 to 2 h	Srinivas et al., 1981
8	Radio frequency wave	Radio frequency of 27.12 MHz with temperature 70- 85 °C were used for 5, 10 and 15 minutes	Vearaksilp et al., 2011

Physicochemical and sensory changes in rice due to ageing

Compared to freshly harvested and milled basmati rice, aged rice is preferred by the consumer because of its perceived enhancement in flavor and taste. Hence traders across the World sell aged rice in order to maximize its commercial value. During the ageing process rice undergoes numerous changes in physicochemical properties like swelling, water uptake, cooking time, stickiness and bulk density. Chemical properties change like amylose, acidity, reducing sugar, starch, enzyme activity and protein. Textural properties include attributes of cohesiveness, hardness, tooth pull, roughness, particle size, tooth pack and looseness of rice grains. These properties are influenced majorly by storage duration. Studies have also revealed that storage of rice increases its 'head rice yield' (i.e., the ratio of mass of head rice obtained after milling to mass of paddy before milling) during milling.

Conclusion

Natural ageing and accelerated ageing both significantly changes the physical, chemical, cooking and textural properties of rice. It is important that accelerated ageing saves the time but performance of this type of ageing is depends on method choose. Availability of accelerated ageing methods are varied and its selection is fully based on the desired attributes. Most Indian people preferred fluffer rice than sticky rice. Changes in physicochemical and cooking properties of rice during storage depend on the duration of ageing. Aged rice has better commercial value, owing particularly to improved milling yield, higher consumer preference in terms of cooked rice texture, flavor and associated parameters.

In addition, during ageing tensile strength, crushing and breaking hardness and resistance to grinding of rice grains increases, Ageing improves pasting property of rice that is an indicator for suitability of rice flour for baking purpose. This results in a product with firmer texture and less stickiness, compared with the cooked counter parts from freshly harvested paddy.

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