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Effect of accelerated ageing on physical properties of BPT 5204

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ABSTRACT : The cooking quality of rice is an important factor influencing the acceptability of consumers. The desirable properties are generally obtained by storing rice, this process known as ageing, Experiments were conducted to investigate the effect of accelerated ageing on physical characteristics of BPT 5204 variety. The samples were prepared by incubating at different temperatures *i.e.*, 90, 100, 110 and 120º C and at different times *i.e.*, 1, 3, 6, 9 hours combinations. Later, samples were stored for 6 months at room temperature. Based on the experimental studies, it was observed that the elongation, elongation ratio and hardness followed the similar trend to that of natural ageing. The temperature, time combinations with storage time significantly effected the properties of rice. The maximum elongation, elongation ratio in artificial ageing of rice was 4.73 mm and 1.655 mm obtained at 100º C temperature for 1 hour time in six month of storage period, respectively. Similarly the maximum elongation, elongation ratio was observed as 2.471mm and 1.456 mm after six month storage in normal room temperature, respectively.

KEY WORDS : Accelerated ageing, BPT 5204, Elongation, Elongation ratio, Hardness

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Rice (*Oryza sativa* L.) is a staple food of people in many parts of the world and is also second most widely consumed cereal in the world, next to wheat. It is cultivated in over 100 countries.

It contains 80 % carbohydrates, 7-8 % protein, 3% fat and 3 % fibre and also provides about 75 % of the calorie and 55 % of the protein in the average daily diet of the people (Anonymous, 2002). As a primary dietary source of carbohydrates, rice plays an important role in meeting energy requirements and nutrient intakes (Yang *et al*., 2006).

The cooking quality of rice is one of the important factors influencing the acceptability of consumers. Such desirable properties are generally obtained by storing process of rice white is known as ageing. Ageing is a natural process, involving physical and chemical changes of rice, modify processing requirements, eating habits and nutritional qualities and finally enhances the commercial value of grains. The natural ageing requires much space for storage of rice, thus leading to high operational cost. Furthermore, rice undergoing ageing is susceptible to damage from insects, micro organisms and rodents. It is therefore, necessary to reduce the ageing time and operating cost, while, at the same time, can maintain the rice properties such as appearance and texture to be similar to those obtained by the conventional ageing process (Soponronnarit *et al*., 2008). The process of inducing the changes in rice in a short time to obtain desirable cooking properties, which resemble that of naturally aged rice, is referred to as accelerated or artificial ageing. It can be accomplished by heating rough or milled rice to high temperature which will deactivate enzyme lipase and thus can slow down the rate of lipid oxidation (Jaisut *et al*., 2009).

The elongation and swelling index increased regularly after 4, 8 and 12 months of rice ageing when stored at room temperature (Sood *et al.*, 2006). Juliono and Gonzales (1989) have observed that the kernel elongation increased during cooking, they also found that ageing could improve fine rice cooking and eating quality. The overall changes may be depends on the rice variety, storage conditions and further treatment (Faruq *et al.*, 2003). The objective of the present investigation was to study the effect of accelerated ageing on the physical characteristics of BPT 5204 rice variety.

METHODOLOGY

Sample preparation:

Freshly harvested BPT 5204 variety paddy were procured from Agricultural college farm, Bapatla and milled with rubber roll sheller in College of Agricultural Engineering, Bapatla.

Artificial ageing:

The rice samples of 40 grams each were incubated at 90, 100, 110 and 120^0 C for different times *i.e.*, 1, 3, 6, 9 hours combinations. Further, the samples were cooled at room temperature for 1 hour then packed in cloth bags and stored for 6 months. The observations were made for every month.

Natural ageing:

The rice samples of 40 grams each stored in cloth bags at room temperature for 6 months and the observations were made for every month.

Elongation:

To measure the elongation, ten aged grains were taken from each sample and measured their length and breadth. Measured grains of each sample were kept in 20 ml glass test tube and soaked for 20 minutes with 5 ml of tap water. After soaking, the test tubes were put into boiling water for around 30 minutes. When the grains cooked properly, test tubes were taken out and removed the water inside the test tubes. Thereafter, cooked grains were kept on a glass sheet for few minutes to evaporate extra moisture and then the length and breadth of the cooked grains were measured with a digital slide calliper.

Calculation:

To calculate the kernal elongation and elongation ratio, the following formulae were used:

$$\textbf{Kernel elongation} = L_f - L_o$$

where, L_f -Average length of 10 cooked grains

L_o-Average length of 10 pre cooked grains.

Elongation ratio:

$$\text{Elongation ratio} = \frac{\text{Average length of 10 cooked grains}}{\text{Average length of 10 precooked grains}}$$

Hardness:

Hardness of rice kernels was determined by using hardness tester which is manually operated. One rice kernel from each treatment was placed on a circular platform horizontally. The pointer of the hardness tester was adjusted to zero initially and then rotated the circular probe manually to apply compression force on the kernel until the kernel break. The force at which kernel breaks was indicated as the hardness of the rice kernel.

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Effect of ageing on Elongation of BPT 5204:

The elongation of incubated rice samples were influenced with temperature from 90^0 C to 120^0 C and also with the incubating time from 1- 9 hours. Variations in actual kernel elongation of BPT 5204 at different temperature and time combinations are shown in Fig. 1, 2, 3 and 4. In one month aged rice, at 90^0 C temperature and 1 hour incubation time, kernel elongation was lowest as 0.250 mm. Kernel elongation increased with increase in incubation time and attained maximum elongation with 7h incubation time as 1.216 mm. At 90^0 C temperature, 7 hours incubation time was recorded best for good elongation for BPT 5204.

At 100, 110 and 120^0 C temperatures, kernel elongation followed the same trend as 90^0 C temperatures. At all the

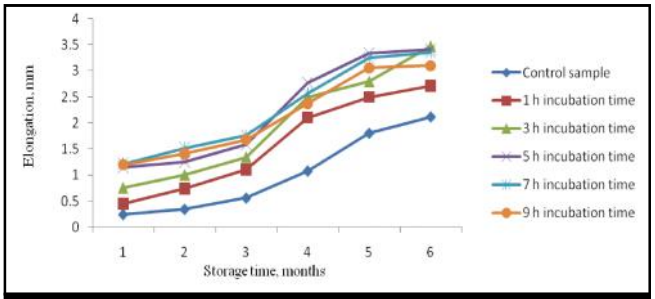

Fig. 1 : Effect of incubating time on elongation of BPT 5204 variety at different levels of storage time at 90 °C

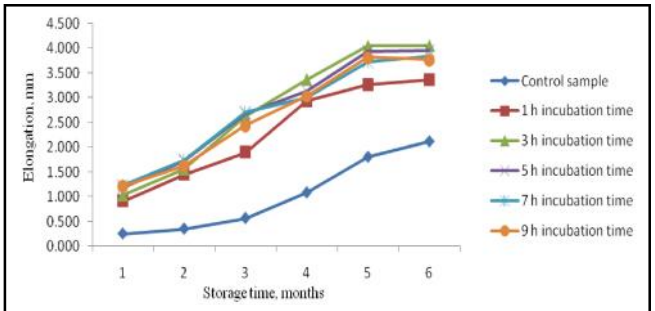

Fig. 2 : Effect of incubating time on elongation of BPT 5204 variety at different levels of storage time at 100 °C

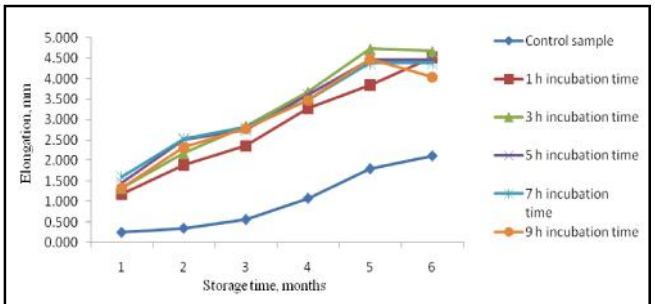

Fig. 3 : Effect of incubating time on elongation of BPT 5204 variety at different levels of storage time at 110 °C

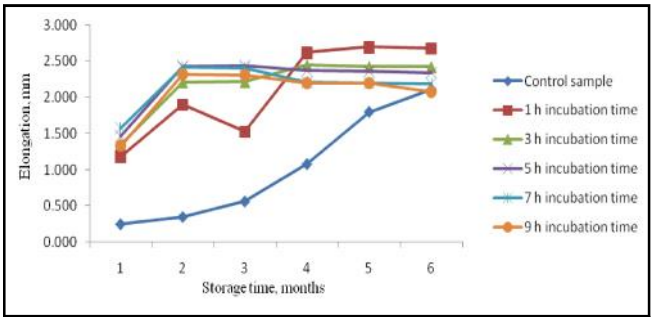

Fig. 4 : Effect of incubating time on elongation of BPT 5204 variety at different levels of storage time at 120 °C

temperatures, lowest kernel elongations were observed at 1hour incubation time and maximum at 7 hours incubation time. In one month aged rice variety of BPT 5204, the good elongation with 110^{0}C – 7 hours combination was best.

In second and third month aged rice, the kernel elongation followed the same trend as that of in one month aged rice samples. After third month of storage time, the maximum elongation was observed at 110^{0}C – 3 hours combination. The maximum elongation was 2.531, 2.842, 3.679, 4.732 and 4.672 mm at 110^{0}C – 7 hours, 110^{0}C - 7 hours, 110^{0}C – 3 hours, 110^{0}C – 3 hours and 110^{0}C – 3 hours in second, third, fourth, fifth and sixth month stored rice, respectively. It is noted that the kernel elongation increased with increase in aged time and also kernel elongation increased significantly in accelerated aged rice than the naturally aged rice.

It is concluded that good kernel elongation *i.e.*, 4.732 mm with 110^{0}C – 3 hours incubation time was best.

Effect of ageing on elongation ratio of BPT 5204:

The elongation ratios of incubated rice samples were followed the same fashion as that of elongation in one month aged rice but attained maximum elongation ratio with 9 hours incubation time as 1.200 mm. Variations in elongation ratios of BPT 5204 at different temperature and time combinations are shown in Table 1. At 100, 110 and 120^{0}C temperatures, kernel elongation ratio followed the same trend as 90^{0}C temperatures but the maximum elongation ratio was obtained at 7 hours incubation time. Kernel elongations ratio were increased with increase in temperature and time. In one month aged rice variety of BPT 5204, the good elongation ratio with 110 °C – 7 hours combination was best.

In second month aged rice, the kernel elongation ratio followed the same trend as that of in one month aged rice samples but in third month of storage time, the maximum elongation ratio was observed at 110^{0}C – 5h combination and after third month storage, the highest elongation ratio was observed at 110^{0}C – 3h. The maximum elongation ratio was 1.463, 1.583, 1.739, 1.912 and 1.976 at 110^{0}C – 7 hours, 110^{0}C - 5 hours, 110^{0}C – 3 hours, 110^{0}C – 3 hours and 110^{0}C – 3 hours in second, third, fourth, fifth and sixth month

Table 1 : Variations in elongation ratio during the ageing of BPT 5204

Temperatures	Conditions	After 1 month	After 2 month	After 3 month	After 4 month	After 5 month	After 6 month
Control		1.050	1.069	1.120	1.202	1.352	1.456
90^{0}C	1 h	1.074	1.140	1.226	1.402	1.497	1.524
	3 h	1.125	1.172	1.279	1.470	1.564	1.701
	5 h	1.181	1.240	1.330	1.536	1.647	1.650
	7 h	1.197	1.262	1.388	1.496	1.632	1.639
	9 h	1.172	1.200	1.342	1.455	1.598	1.605
100^{0}C	1 h	1.192	1.259	1.390	1.569	1.646	1.655
	3 h	1.203	1.278	1.543	1.658	1.794	1.800
	5 h	1.224	1.308	1.512	1.621	1.771	1.821
	7 h	1.190	1.243	1.498	1.596	1.742	1.788
	9 h	1.200	1.239	1.510	1.612	1.761	1.789
110^{0}C	1 h	1.230	1.347	1.526	1.646	1.742	2.080
	3 h	1.249	1.398	1.601	1.739	1.912	1.881
	5 h	1.354	1.461	1.583	1.702	1.873	1.832
	7 h	1.201	1.240	1.568	1.687	1.838	1.809
	9 h	1.220	1.249	1.577	1.698	1.852	1.828
120^{0}C	1 h	1.158	1.193	1.321	1.512	1.602	1.766
	3 h	1.179	1.221	1.364	1.482	1.593	1.632
	5 h	1.148	1.200	1.246	1.464	1.587	1.678
	7 h	1.132	1.187	1.232	1.438	1.570	1.644
	9 h	1.118	1.154	1.237	1.441	1.582	1.657

Table 2 : Variations in hardness during ageing of BPT 5204

Conditions		After 1 month	After 2 month	After 3 month	After 4 month	After 5 month	After 6 month
Control		0.76	0.80	0.88	1.00	1.20	1.32
90^0C	1 h	0.76	0.84	0.96	1.04	1.28	1.38
	3 h	0.80	0.86	1.00	1.12	1.32	1.40
	5 h	0.88	0.92	1.08	1.16	1.36	1.44
	7 h	0.88	1.00	1.12	1.28	1.40	1.44
	9 h	0.90	1.02	1.14	1.28	1.36	1.48
100^0 C	1 h	0.78	0.86	1.08	1.12	1.32	1.40
	3 h	0.82	0.88	1.12	1.26	1.40	1.44
	5 h	0.92	0.96	1.20	1.38	1.44	1.48
	7 h	1.00	1.08	1.24	1.40	1.52	1.52
	9 h	1.04	1.08	1.32	1.42	1.56	1.54
110^0 C	1 h	0.84	0.96	1.16	1.20	1.34	1.44
	3 h	0.92	1.02	1.20	1.28	1.40	1.50
	5 h	0.96	1.08	1.28	1.42	1.44	1.52
	7 h	1.00	1.08	1.32	1.40	1.48	1.52
	9 h	1.08	1.12	1.44	1.42	1.54	1.56
120^0 C	1 h	0.84	1.00	1.20	1.16	1.36	1.40
	3 h	0.92	1.04	1.28	1.24	1.44	1.52
	5 h	1.04	1.08	1.32	1.28	1.46	1.48
	7 h	1.10	1.10	1.44	1.38	1.44	1.48
	9 h	1.10	1.16	1.48	1.44	1.56	1.50

stored rice, respectively. It is noted that the kernel elongation ratio increased with increase in aged time and also kernel elongation ratio increased significantly in accelerated aged rice than the naturally aged rice.

Hardness:

In Natural ageing of rice, the kernel hardness has increased from 0.76 kg after first month incubation time to 1.32 kg in sixth month aged rice as shown in Table 2. Similarly, in accelerated ageing, the hardness of kernel has increased from 0.76 kg to 1.56 at 100^0 C – 9 hours combination. It is also seen that the hardness of kernel increased with increase in incubated time and also with the incubated temperature. The kernel hardness was more in accelerated aged rice than naturally aged rice.

Conclusion:

Ageing is one of the most influencing factor to improve rice cooking and eating quality. The physical properties of rice like elongation, elongation ratio, and hardness increased during accelerated ageing. The extent to which these changes occur seems to be depend upon the change in different time and temperature combination. In natural aging, the changes in physical characteristics followed the similar fashion as that of accelerated ageing but takes a long time to occur which is not economically feasible for the industry. Based on the elongation and elongation ratio, it was concluded that 110 ºC and 3 h is the optimum time and temperature combination for BPT 5204 variety.

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REFERENCES

Anonymous (2002). National workshop on Rice Research and Extension-2002. Feeding the extra millions by 2025. Bangladesh Rice Research Inst. Gazipur, p:1.

Faruq, G., Mohamad, O., Hadjim, M. nad Meisner, C.A. (2003). Kernel ageing: An analysis in four Malaysian rice varieties. *Internat. J. Agric. & Biol.,* **5**(3) : 230-232.

Faruq, G., Mohamad, O., Hadjim, M. and Meisner, C.A. (2003). Optimization of aging time and temperature for four Malaysian rice cultivars. *Pakistan J. Nutrition*, **2**(3) : 125-131.

Jaisut, D., Prachayawarakorn, S., Varanyanond, W., Tungtrakul, P. and Soponronnarit, S. (2009). Accelerated aging of jasmine brown rice by high-temperature fluidization technique. *Food Res. Internat.*, **42** (5-6) : 674-681.

Juliano, B.O. (1971). A simplified assay for milled rice amylose. *Cereal Sci. Today*, **16**: 334-338.

Sood, D.R., Singh, A.P. and Silpa (2006). Changes in cooking behaviour of Basmati and non Basmati rice genotypes during storage. *J. Darirying, Foods & H.S.,* **25**(2) : 92-96.

Soponronnarit, S., Chiawwet, M., Prachayawarakorn, S., Tungtrakul, P. and Taechapairoj, C. (2008). Comparative study of physicochemical properties of accelerated and naturally aged rice. *J. Food Engg.*, **85** (2) : 268-276.

Yang, C.Z., Shu, X.L., Zhang, L.L., Wang, X.Y., Zhao, H.J., Ma, C.X. and Wu, D.X. (2006). Starch properties of mutant rice high in resistant starch. *J. Agric. & Food Chem.*, **54** (2) : 523-528.