Cooking and organoleptic quality of pre-treated foxtail millet (*Setaria italica*) rice

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ABSTRACT

The present study was conducted to know the effect of pre-treatment on the cooking quality, functional properties, visual appearance and organoleptic quality in comparison with raw foxtail millet grains. Different pre-treatments were given to the millet grains in different combination such as roasting; cooking and drying; cooking, drying and roasting; soaking, steaming and drying; soaking, steaming, drying and roasting. Pre-treatments decreased cooking time (11.66 to 5.33 min) and per cent solubility (6.72 to 2.08 %). Pre-treatment increased cooked weight (28.66 to 37.33 g), cooked volume (23.66 to 32.33 ml) and swelling power (5.60 to 6.77 g/g). Pre-treatments decreased the visual appearance of grains. Cooked rice of pre-treated grains affected appearance, colour and texture in organoleptic evaluation. Each above mentioned quality characters was ranked and scores were given. As cooked dried and roasted grains got high total score than other pre-treatments, it can be used as ready to eat convenient rice.

Key words: Cooking quality, Organoleptic quality, Pre-treatments, Visual appearance.

INTRODUCTION

Millets are small seeded annual cereal grains. These are very hard crops and can be grown successfully in infertile lands. In the present era of food scarcity there exists a need to diversify the uses of millets by developing millet products. The accelerated pace of modern life has promoted new ways to consume rice such as instant rice, also known as quick cooking rice (QCR), which is fully or partially cooked and dehydrated. QCR takes only a few minutes (less than 5 min) to prepare for consumption after rehydration (Wang et al., 2011). Thermal processing has long been used as a common preservation technique in the food industry, which allows the stable and secure production of food. Roasting of cereals, pulses and oilseeds is a simpler and more commonly used household and village level technology which is reported to remove most antinutritional or toxic effects and increase storage life. Roasting process render the grain digestible, without the loss of nutritious components (Huffman and Martin, 2004). Some of the advanced technologies as reported by Yu et al. (2015) pre-treatment like soaking, ultrasound, plasma and PHHP (pre-soaking high hydrostatic pressure) reduced the cooking time of brown rice. Instant rice was developed by the method of soaking, boiling, and washing prior to freezing and drying (Kongseroe et al., 2002). In the present study also pre-treatments like roasting, soaking, steaming, cooking and drying were tried in different combinations to select the best pre-treatment for development of ready to eat millet rice and also development of convenient upma mix. Upma is a common South Indian breakfast dish cooked from roasted wheat and rice semolina or broken rice. It is very convenient and easy to cook breakfast dish. As millets are small seeded grains different pre-treatments were applied for decorticated grains. The pre-treated grains were studied for the changes in functional property relating to cooking quality, visual appearance, and organoleptic evaluation.

MATERIALS AND METHODS

Commercially available decorticated foxtail millet (*Setaria italica*) grains were procured in bulk from the miller of village, Timmapur, Haveri District, stored in cold storage room and used throughout the research work. Different pre-treatments viz., roasting, cooking, soaking, steaming and drying were given in combinations as mentioned in Table 1. The various physical characteristics like thousand grain weight, thousand grain volume and grain density were studied for raw foxtail millet grains according to the procedure followed by Mannurmath and Yenagi (2014). A known quantity raw and pre-treated little millet grains were taken and studied for cooking quality such as cooking time, cooked weight, cooked volume, swelling power and per cent solubility. Cooked time, cooked weight and cooked volume were determined according to the procedure followed by Nazni and Shobana (2016). The swelling power and per cent solubility was determined according to the method used by Schoch (1964). Visual appearance of raw and pre-treated foxtail millet grains and organoleptic evaluation of cooked rice of pre-treated little millet grains were carried out using nine point hedonic scale by a panel of 10 semi-trained judges.

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The quality of pre-treated grains was assessed based on the visual appearance, cooking quality and functional properties like swelling power, solubility and organoleptic evaluation of cooked grains. Each quality character was ranked on descending order and scores were given as 1 for rank V and 5 for I rank.

All analyses were performed in triplicates (n=3) and the data was presented as mean ± SD. The difference between the functional properties, visual appearance and organoleptic evaluation were done by one-way ANOVA.

**RESULTS AND DISCUSSION**

Physical characteristics of raw foxtail millet grains revealed that thousand kernel weight of little millet grain was 2.47 g. Volume of foxtail millet grains was 1.83 ml and density was 1.35 g/ml. Nazni and Shobana (2016) reported 1000 kernel weight and volume of foxtail millet was 2.64 g and 2.96 ml respectively. Results were lower as reported by earlier studies. This may be due to varietal difference of the millet grains.

Table 2 depicts functional properties of raw and pre-treated little millet grains. Cooking time of raw little millet was 11.66 min. Cooking time of pre-treated grains ranged from 5.33 to 10.33 min. Pre-treatment decreased the cooking time. Cooking time of pre-treated millet grains varied significantly (p < 0.05). Per cent reduction in cooking time ranged from 11.46 per cent to 54.28 per cent. Maximum reduction in cooking time was observed in cooked and dried grains followed by soaked, steamed and dried grains. This may be due to partial or complete gelatinization of starch during cooking. Cooking weight and volume of raw little millet grain was 28.66 g and 23.66 ml. Cooked weight of pre-treated grains ranged from 27.33 to 37.33 g and volume ranged from 24.33 to 32.33 ml. Pre-treatment increased the cooked weight except soaked steamed dried grains. Maximum increase in cooked weight and volume was observed in cooked, dried and roasted (37.33 g and 32.33 ml) grains. It indicated that it absorbed more water compared to other pre-treatments this may be due to hardness of the grains and also amylose-amylopectin content of starch. Earlier study of Khatoon and Prakash (2007) reported that hydration, cooking and expansion (in turn starch gelatinization) were better in pressure cooking method as compared to other methods. Swelling power of raw little millet grain was 5.60 g/g. Swelling power of raw foxtail millet grain was 5.60 g/g respectively. Swelling power of pre-treated millet grains varied significantly (p < 0.05). Swelling power of pre-treated grains ranged from 5.26 to 6.77 g/g.
Swelling power decreased in roasted and soaked steamed dried grains whereas it increased in other pre-treatments. Maximum was observed in cooked dried and roasted grains (6.77 g/g) and minimum was observed in roasted (5.26 g/g) grains. This may be due to disruption of crystalline structure due to hydrogen bonding during cooking and water molecules become linked by hydrogen bonding to the exposed hydroxyl group of amylose and amylopectin, this in turn results in swelling (Eliasson, 2004). Earlier study of Mannurmath and Yenagi (2015) reported modification of starch granules during hydrothermal treatment which resulted in less water absorption and less swelling power. Solubility of raw foxtail millet grain was 8.39 per cent. Solubility of pre-treated grains ranged from 2.08 to 6.72 per cent. Pre-treatment decreased the solubility significantly. Maximum reduction was observed in cooked, dried and roasted (2.08 %) followed by soaked steamed dried and roasted (2.09 %) and minimum reduction was observed in roasted (6.72 %) grains. This may be due to compactness of the starch granule and the starch is more difficult to overflow outside the granules and thus lowers solubility values (Ali et al., 2012).

Table 3 shows visual appearance scores of foxtail millet grains. Significant difference was observed in appearance, colour and overall acceptability of different pre-treated foxtail millet grains. Mean scores for appearance ranged from 6.70 to 8.60. Pre-treatment roasting significantly increased the appearance (8.60) whereas it decreased significantly due to other pre-treatments. Least score was

| Pre-treatments               | Appearance | Colour | Overall |
|-----------------------------|------------|--------|---------|
| Raw                         | 8.27 ± 0.64| 8.00 ± 0.63| 8.18 ± 0.60|
| Roasted                     | 8.60 ± 0.69| 8.40 ± 0.69| 8.20 ± 0.78|
| Cooked and dried#           | 6.80 ± 1.03| 6.60 ± 0.84| 6.80 ± 1.13|
| Cooked, dried and roasted   | 6.81 ± 0.98| 6.63 ± 0.67| 6.90 ± 0.73|
| Soaked, steamed and dried   | 6.70 ± 0.82| 7.10 ± 0.73| 6.80 ± 0.63|
| Soaked, steamed, dried and roasted | 7.00 ± 0.81| 7.10 ± 1.19| 6.72 ± 0.90|

S.E.m ± 0.53 0.53 0.53 0.51
C.D. (5 %) 0.75** 0.72** 0.73**
F value 10.25 8.42 8.00

#Pressure cooked rice  **Significant @ 1 % level, NS-Non-significant, Mean ± SD

Table 4: Organoleptic evaluation of cooked rice of pre-treated foxtail millet grains.

| Pre-treatments               | Appearance | Colour | Flavour | Taste | Texture | Overall |
|-----------------------------|------------|--------|---------|-------|---------|---------|
| Roasted                     | 8.60 ± 0.51| 8.40 ± 0.51| 7.80 ± 0.63| 8.10 ± 0.99| 8.00 ± 0.66| 7.90 ± 0.93|
| Cooked and dried#           | 7.63 ± 0.92| 8.09 ± 0.30| 7.72 ± 0.90| 8.09 ± 1.13| 7.63 ± 0.50| 7.80 ± 0.63|
| Cooked, dried and roasted   | 8.50 ± 0.52| 8.50 ± 0.70| 8.00 ± 1.15| 7.60 ± 0.84| 7.70 ± 0.67| 8.10 ± 0.87|
| Soaked, steamed and dried   | 8.20 ± 0.78| 8.10 ± 0.56| 7.30 ± 1.05| 7.00 ± 0.94| 7.00 ± 1.05| 8.09 ± 0.94|
| Soaked, steamed, dried and roasted | 7.30 ± 1.41| 7.30 ± 1.63| 7.20 ± 1.75| 7.10 ± 1.37| 6.90 ± 1.19| 7.50 ± 0.97|

S.E.m ± 0.56 0.54 0.72 0.67 0.47 0.53
C.D. (5 %) 0.80** 0.77* NS NS 0.67** NS
F value 3.95 2.93 0.87 2.43 3.25 0.87

#Pressure cooked rice  *Significant @ 5 % level, **Significant @ 1 % level, NS-Non-significant, Mean ± SD

Table 5: Ranking and total scores of pre-treated foxtail millet grains for different cooking and functional qualities.

| Quality characteristics       | Roasted | Cooked and dried# | Cooked, dried and roasted | Soaked, steamed and dried | Soaked, steamed, dried and roasted |
|-------------------------------|---------|-------------------|---------------------------|---------------------------|-------------------------------|
| Cooking time                  | V       | 5                 | 5                         | 5                         | 4                             | IV 2                          |
| Cooked weight                 | IV      | 2                 | 4                         | 1                         | IV                            | 2                             |
| Cooked volume                 | III     | 3                 | 4                         | 1                         | IV                            | 3                             |
| Swelling power                | II      | 4                 | IV                        | 2                         | IV                            | 4                             |
| Solubility                    | V       | 1                 | 2                         | IV                        | 2                             | IV                            |
| Sensory scores                | V       | 1                 | 2                         | III                       | 3                             | IV                            |
| Visual appearance             | III     | 3                 | 4                         | 1                         | IV                            | V                             |
| Total scores                  | 15      | 25                | 33                        | 19                        | 17                            |

# Pressure cooked rice  Ranking pattern – Rank I to V  Scoring pattern – Rank I-5, II-4, III-3, IV-2, V-1
observed for soaked, steamed and dried (6.70) grains. Mean scores for colour ranged from 6.60 to 8.40. Colour increased significantly in roasted grains (8.40) whereas in other pre-treatments it decreased significantly. Least score was observed for cooked and dried (6.60) grains. Mean scores for overall acceptability ranged from 6.72 to 8.20. There was no significant difference observed in roasted grains when compared with raw grains whereas other pre-treatments resulted in decreased overall acceptability. Roasted grains (8.20) had higher score and least score observed for soaked, steamed, dried and roasted (6.72) grains. This may be due to changes in grain structure due to pre-treatment. Roasted grains retained their structure after roasting also whereas in other pre-treated grains lost their shape. In cooked and dried grains formation of lumps was observed as well as it lost its lustre (Plate 1).

Table 4 represents organoleptic evaluation scores of cooked rice of pre-treated foxtail millet rice. There was no significant difference observed between the rice prepared from different pre-treated foxtail millet grains in all characters like flavour, taste and overall acceptability whereas significant difference was observed in appearance, colour and texture. R had highest scores in appearance (8.60) and texture (8.00) whereas cooked, dried and roasted grain rice scored highest score other attributes like colour (8.50), Flavour (8.00), overall acceptability (8.10). Least score was observed for soaked, steamed, dried and roasted grain rice in all attributes expect for taste. Soaked, steamed and dried grain rice scored least for taste (7.00). Low scores may be due to hardness and reduction in size of soaked, steamed and dried grain rice (Plate 2).
Table 5 depicts ranking and total scores of pre-treated foxtail millet grains for different cooking and functional qualities. Out of 35 scores roasted grains scored 15, cooked and dried scored 25; cooked, dried and roasted scored 33; soaked, steamed and dried scored 19; and soaked, steamed, dried and roasted 17. As cooked, dried and roasted grains scored highest it was selected as best pre-treatment.

The study concludes that pre-treatment of foxtail millet grains by cooking, drying and roasting resulted in effective reduction in cooking time and improved the cooking quality without affecting the organoleptic quality of cooked rice.

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