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RESEARCH ARTICLE

STUDIES ON DRYING CHARACTERISTICS AND NUTRITIONAL COMPOSITION OF SPROUTED WHEAT AND FINGER MILLETS

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ABSTRACT

Sprouting and roasting of wheat and finger millets supposed to increase the nutritive value and decrease the antinutritional factors. These roasted and sprouting finger millets and wheat could find application in development of various weaning food preparations. In present investigation, efforts were made to study change in nutritional properties of sprouted wheat and finger millet. Further two different methods of drying viz. solar and Infra red drying, were implied to analyze the effect of drying method on nutritional composition. The results revealed that infra-red drying drastically reduces the time required for drying of sprouted wheat and finger millets. However, nutrient losses in case of infra-red drying observed to be higher compared to that of sun drying.

INTRODUCTION

Sprouting is reported to be associated with improvement in the nutritive value of seeds (Badshah *et al.*, 1991; Sattar *et al.*, 1995). Several nutritive factors such as vitamin concentrations and bioavailability of trace elements and minerals are reported to increase during germination (Khattak *et al.*, 2007). At the same time there are indications that germination is effective in reducing phytic acid and flatulence causing oligosaccharides stachyose and raffinose, increasing protein digestibility and improving sensory properties (Lintschinger *et al.*, 1997). Fermentation and sprouting (Khetarpaul and Chauhan, 1991) have been reported to improve in vitro protein quality, starch digestibility and overall acceptability score by sensory panelists in germinated flour. Finger millet (*E. coracana*) is also known as African millet or Ragi. India is one of the largest countries in the production of ragi and wheat. Wheat and ragi are used in production of various products. The sprouting is done on the wheat and ragi to improve its nutrition value. During sprouting there were various biochemical changes occurred in the sample. The sprouted ragi and wheat can be used for production of infant's foods. The process of cereal seed germination has been used for centuries for the purpose of softening the kernel structure, improving its nutritional value, and reducing anti-nutritional effects. In fact, the germination process is also one of methods used to improve the functionality of oat seed protein (Kaukovirta *et al.*, 2004). During germination, oat seed proteins were degraded to increase the soluble protein content (Wu, 1983), and the oat protein properties were improved without any chemical modifications being required. After germination and subsequent drying, oat malts can be used as good replacements for barley malt in the brewing industry, and also can be used as ingredients in some convenience foods (Taylor *et al.*, 1998). The chemical composition of malted oat seeds depends on the conditions and the level of germination (Wilhelmson *et al.*, 2001), and its sensory profile depends on the processing parameters of subsequent drying such as drying speed and temperature profile (Heinio *et al.*, 2001), as well as drying methods. Therefore, the level of germination and drying will affect oat product quality and commercial utilization. Belt conveyor, rotary, fluid bed, solar drying and open sun drying methods are widely use in drying of grains. Germinated and sprouted wheat and finger millets needed to be dried before utilization in new product formulation. Usually sun drying is commonly used method for drying of sprouted wheat and finger millets. In present investigation, efforts were made to study the effect of sprouting on nutritional composition of wheat and finger millet. Further, infra red method of drying

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was implied and studied for its suitability in comparison of traditional sun drying.

MATERIALS AND METHODS

Materials

The good qualities wheat and finger millet were purchased from the local market. The grains were cleaned and unwanted materials including stones, broken grains, sand, etc were separated followed by subsequent washing. The sprouting was done in two steps. Initially 0.5 kg of wheat and ragi were soaked in 2 liter distilled water for 6 hr at 20^{o}C. Excess water was drained off and the water present superficially on grain was removed through filter paper. The soaked sample were then sprouted for 72 hr at 20^{0}C temperature at a controlled incubator. After 8 hr the samples were washed by distill water to avoid the formation of mould. During soaking about 42 to 46 per cent and 32 to 36 per cent water were absorbed by the wheat and ragi sample respectively. The methods used for drying were solar and infra-red. The drying was done at 55□C for infra-red and solar dryer.

Methods

Germination of wheat and finger millet was took place in two steps.

1) **Soaking :** 0.5 kg of wheat and ragi were soaked in 2 liter distilled water for 6 hr at 20°C. Excess water was drained off and the water present superficially on grain was removed through filter paper then it was kept for germination.
2) **Sprouting:** The soaked sample were then sprouted for 72 hr at 20°C temperature at a controlled incubator. The samples were washed by distill water after 8 hr interval to avoid mould and fungus infection. After germination the sprouted wheat and finger millet were dried till 10-15% remains. The drying was done by solar and infra-red dryer.
3) **Drying:** The solar and infra- red drying was done at 55ºC till 8 - 15 % moisture remain in sample. The weights of samples were calculated for regular intervals of time to calculate the drying kinetics. During drying after some interval displacement of samples must be done.

Proximate Composition

Determination of Moisture Content: Moisture content was determined for randomly selected fruit slices. The samples were oven dried at $\pm$ 105^{0}C for 12 h in pre-weighed Petri dishes with removed lids AOAC (1990). After drying petri dishes were covered with lid and cooled in desiccators containing silica gel for 1 h before weighing. Moisture content of whole sample is calculated by,

$$\text{Dry matter} = \frac{(W2-W3)}{(W3-W1)} \times 100$$

$$\text{Moisture Content}(\%\ d.b) = \frac{(W2-W3)}{(W3-W1)} \times 100$$

$$\text{Moisture Content}(\%\ w.b) = \frac{(W2-W3)}{(W2-W1)} \times 100$$

Where, W_1, W_2 and W_3 are weights of empty Petridish, Petridish + sample before drying and Petridish + sample after drying. The initial moisture content of the sample was found to be in the range of 79.90 to 81.09% respectively on dry basis. Conversion formulae:

Wet basis to dry basis

$$\%\ \text{Moisture Content (Dry basis)} = \frac{100 \times \%(w.b)}{100 - \%(w.b)}$$

Dry basis to wet basis

$$\%\ \text{Moisture Content (Wet basis)} = \frac{100 \times \%\ M.C(d.b)}{100 + \%\ M.C(d.b)}$$

Determination of Protein content: Protein content was determined by Microkjheldhal method (N×6.25) as per procedure of A.O.A.C (1990).

$$\%\ N = \frac{(\text{Sample}-\text{balnk}) \times \text{N of HCL} \times 0.014 \times 6.25 \times 100}{\text{Aliquote taken} \times \text{Wt of sample(gm) taken}}$$

Determination of Fat content: Fat content was determined by extracting 0.5 g of powdered sample using petroleum ether (60-80^{o} fraction) as solvent (AOAC, 1990) using semiautomatic SOCS PLUS SCS 4 equipment.

$$\%\ \text{Crude fat} = \frac{\text{Wt of ether soeluble material} \times 100}{\text{Wt of sample}}$$

Determination of Ash content: Ash content was determined by the method of A.O.A.C. (1990). Take 5 g of sample in silica crucible was ignited on low flame till smokeless and incinerated in muffle furnace at 550^{0}C for 5 hours. It was then cooled in desiccators and weighed.

$$\%\ \text{Ash} = \frac{\text{Wt of ash}}{\text{Wt of sample}} \times 100$$

RESULTS AND DISCUSSION

Drying Curves

The graph was plotted between moisture content Vs time required to reduce moisture from the grapes. The time was in minute and the moisture content was in percentage. The sprouted wheat sample content initial moisture 42.66%. The time required to dry sprouted wheat sample by solar drier was 105 minute. Final moisture content of dried wheat was 8.32%. The sprouted ragi sample content initial moisture 41.99%. The time required to dry sprouted ragi sample by solar drier was 75 minute. The final moisture content of dried sample was 9.32% as shown in Figure 1. This graph showed that as the time increased the moisture content get. At starting point the moisture ratio was 1, as time increased the moisture ratio get decreased. At initial stage the drying rate was more, as time proceeds the drying rate decreased. The sprouted wheat sample content initial moisture 33%.The time required to dry sprouted wheat sample by infra-red dyer was 38 minute. Final moisture content of dried wheat sample was 11.02%. The sprouted ragi sample content initial moisture 44%. The time required to dry sprouted ragi sample by infra-red dyer was 26

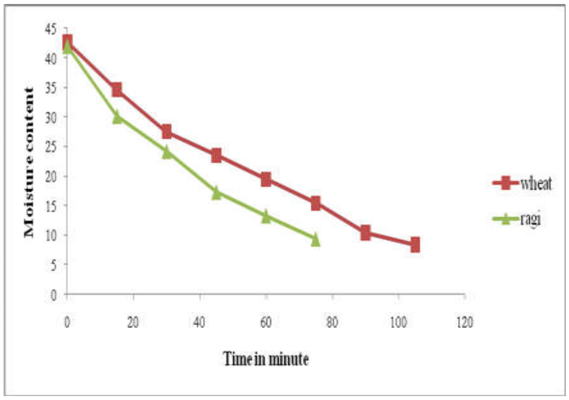

Fig. 1: Drying curve for solar dryer sprouted wheat and ragi at 55°C

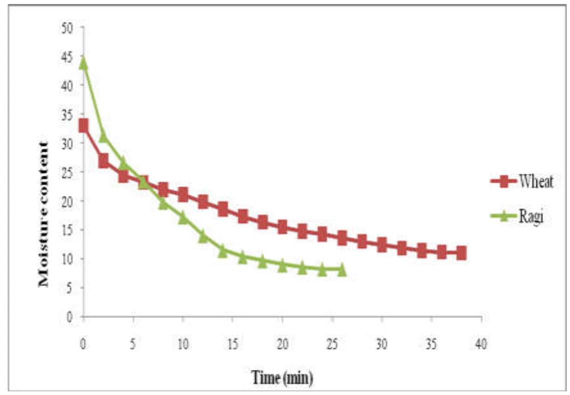

Fig. 2: Drying curve for infra-red dryer sprouted wheat and ragi at 55°C

Table 1: Analysis of raw and sprouted wheat and ragi samples

Content (%)	Raw wheat	Raw ragi	Sprouted wheat	Sprouted ragi
Moisture	7.15 ± 0.42	11.14± 0.37	42.66 ± 0.34	42.52 ± 0.54
Fat	1.47 ± 0.51	1.06 ± 0.04	0.60 ± 0.01	0.79 ± 0.05
Protein	7.71 ± 0.36	6.12 ± 0.26	10.85 ± 0.68	8.94 ± 0.08
Ash	1.43 ± 0.02	2.13 ± 0.41	0.85 ± 0.04	0.96 ± 0.07
Carbohydrate (by difference)	82.22 ± 1.41	79.52 ± 1.64	45.02 ± 1.25	46.75 ± 1.03
Starch	70.65 ± 1.08	69.26 ± 0.84	28.32 ± 0.98	27.79 ± 0.78
Total Sugar	2.5 ± 0.05	1.33 ± 0.06	3.54 ± 0.03	2.94 ± 0.07

Table 2: Analysis of solar and infra-red dried sprouted wheat and ragi samples

Content (%)	Solar dried wheat	Solar dried ragi	IR dried wheat	IR dried ragi
Moisture	13.70 ± 0.35	12.22 ± 0. 48	13.64 ± 0.75	11.53 ± 0.49
Fat	0.95 ± 0.05	1.09 ± 0.04	2.74 ± 0.04	2.75 ± 0.06
Protein	11.69 ± 0.77	8.72 ± 0.54	8.13 ± 0.15	8.21 ± 0.74
Carbohydrate (by difference)	72.29 ±2.22	76.26 ± 1.43	74.45 ±2.12	76.69 ±1.54
Ash	1.36 ± 0.05	1.69 ± 0.08	1.01 ±0.06	0.79 ± 0.02
Starch	54.48 ± 0.64	69.18 ± 0.64	51.83 ± 1.05	64.73 ± 1.17
Total Sugar	4.38 ± 0.04	1.68 ± 0.10	3.93 ± 0.07	1.28 ± 0.06

minute. The final moisture content of dried ragi sample was 8.26% as shown in Figure 2. Infra red drying method showed to reduce drying time drastically. Drying of sported wheat by sun drying method taken the time period of approximately 105 min while same moisture content of was observed at the period of 38 min in case of infra red drying. In case of ragi, drying time was reduced from 75 min to 26 min through infra red drying as compared to sun drying. On the basis of drying curve of infra red and solar drying of sprouted wheat and ragi, in could be concluded that infra red drying is superior to solar drying in terms of drying periods.

Analysis of wheat and ragi

The process of cereal seed germination has been used for centuries for the purpose of softening the kernel structure, improving its nutritional value, and reducing anti-nutritional effects. During germination, seed proteins were degraded to increase the soluble protein content. Several nutritive factors such as vitamin concentrations and bioavailability of trace elements and minerals are reported to increase during germination (Khattak *et al.*, 2007). The results pertaining to nutritional compositions of raw and sprouted wheat and ragi samples are presented in Table 1. During germination some biochemical changes were takes place that affect on the nutrients composition of wheat and ragi.

During germination some biochemical changes were takes place that affect on the nutrients composition of wheat and ragi. There was increment in protein content of sprouted samples than raw samples. Sprouted samples contain less fat than raw samples. The total sugar of sprouted samples was more than raw samples. Raw wheat and ragi content 70.65% and 69.26% starch respectively. The starch content of sprouted wheat and ragi were 28.32% and 27.79%. These starch get converted into sugar i.e. glucose due to enzyme activities. The total sugar content of sprouted wheat and ragi were 3.54% and 2.94%. Raw wheat and ragi content 2.5% and 1.33 % total sugar respectively. Free amino acid contents increased continuously after germination. Hence there was increment in protein content of the samples. Protein content of sprouted wheat and ragi were 10.85% and 8.94%. Raw wheat and ragi content 7.71% and 6.12 % protein respectively. The reason is that the proteins in the raw samples were degraded and converted into a soluble state after germination. It was remarkable facts that free amino acids content decreased during steeping, mostly during the initial germination stage. The speed of utilizing the amino acid to synthesize the bioenzymes was faster than the proteins were being degraded into amino acids. A decrease in the starch content was observed after 72 hr germination, compared with raw samples. The total amylase activity increased rapidly due to which starch get converted into sugar. The sprouted wheat and ragi samples were drier by solar and infra- red dryer. The losses due to infra-red dryer were more than that of solar dryer. Solar dryer samples contain more protein than infra-red dryer samples. The solar dried sprouted wheat samples contain 11.69% protein and infra-red dried sprouted wheat samples contain 8.13% protein. The solar dried sprouted ragi samples contain 8.72% protein and infra-red dried sprouted ragi samples contain 8.21% protein. The solar dried sprouted wheat samples contain 4.38% total sugar and infra-red dried sprouted wheat samples contain 3.93% total sugar. The solar dried sprouted ragi samples contain 1.68% total sugar and infra-red dried sprouted ragi samples contain 1.28% total sugar. Also it affect on the total sugar composition. Solar dried samples contain more sugar than infra- red dried samples. During drying the amylase activity get decrease slowly, thus only few amount of starch of sprouted samples get converted into the sugar. The starch content of dried sample was less than that of raw samples. The protein content of dried samples was more than that of raw samples. The nutrients losses by infra-red dryer were more than solar dryer as shown in above Table 2.

CONCLUSIONS

The conversions of various nutrients were take place due to the biochemical changes during sprouting, drying and roasting. During sprouting there was increment in total sugar, protein content. The time required for drying of sprouted wheat by solar dryer was 105 minutes and that of by infra-red dryer was 38 minutes. The time required for drying of sprouted ragi by solar dryer was 75 minutes and that of by infra-red dryer was 26 minutes. On the basis of drying curve, it could be concluded that infra-red drying is superior to solar drying in terms of drying time while the nutrients losses in infra-red drying were greater than solar drying.

REFERENCES

AOAC, 1990. Official method of analysis. No. 934.06. Association of Official Analytical Chemist, Arlington, USA.

Badshah, A., Zeb, Anurang and Sattar, A. 1991. Effect of soaking, germination and autoclaving on selected nutrients of rapeseed. *Pakistan Journal of Scientific and Industrial Research*, 34, 446–448.

Heiniö, R. L., Oksman-Caldentey, K. M., Latva-Kala, K., Lehtinen, P and Poutanen, K. 2001. Effect of drying treatment conditions on sensory profile of germinated oat. *Cereal Chemistry*, 78(6):707–714.

Kaukovirta N. A., Wilhemson, A. and Poutanen, K. 2004. Germination: A means to improve the functionality of oat. *Agricultural and Food Science*, 13:100–112.

Khattak, A. B., Zeb, A., Bibi, N., and Khattak, M. S. 2008. Effect of germination time and type of illumination on proximate composition of chickpea seed (*Cicer arietinum* L.). *American Journal of Food Technology*, 3(1): 24–32.

Khetarpaul, N. and Chauhan, M. 1991. Effect of natural fermentation on antinutrients and in vitro digestibility of starch and protein in pearl millet flour. *Journal of the Science of Food and Agriculture*, 55:189–195.

Lintschinger, J., Fuchs, N., Moser, H., Jager, R., Hlebeina, T., Markolin, G., and Gossler, W. 1997. Uptake of various trace elements during germination of wheat buckwheat and quinoa. *Plant Foods for Human Nutrition*, 50: 223–237.

Sattar, A., Shah, A. B. and Zeb, A. 1995. Biosynthesis of ascorbic acid in germinating rapeseed cultivars. *Plant Food for Human Nutrition*, 47:63–70.

Taylor, D. G., Humphrey, P. M., and Smith, P. J., 1998. Brewing of English-style ales with malted cereals, other than barley. *Technical Quarterly*. 35(1): 20–23.

Wilhelmson, A., Oksman-Caldentey, K. M., Laitila, A., Suortti, T., Kaukovirta-Norja, A., and Poutanen, K. 2001. Development of a germination process for producing. High b-glucan, whole grain food ingredients from oat. *Cereal Chemistry*, 78(6):715–720.

Wu, Y.V. 1983. Effect of germination on oats and oat protein. *Cereal Chemistry*, 60(6): 418–420.

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