International Journal of Agriculture and Food Science Technology.
ISSN 2249-3050, Volume 4, Number 3 (2013), pp. 215-220

http://www.ripublication.com/ ijafst.htm

Influence of Germination on Physico – chemical Properties of Amaranth (*Amaranthus Spp.*) Flour

Arti Chauhan[1] and Sukhcharns Singh[1]

[1]*Department of Food Engineering and Technology, Sant Longowal Institute of Engineering & Technology, (SLIET), Sangrur, Punjab–148106, India.*

Abstract

Amaranth is a pseudo-cereal and excellent source of superior quality protein (rich source of lysine) which is deficient in wheat and other cereals. Germination is a natural biological process used for many years to enhance the nutritional value of cereals and leguminous plants. The aim of this study was to determine the influence of germination process of amaranth (Amaranthus spp.) grains on their proximate composition and physico – chemical properties like bulk density, water absorption index and water solubility index. The grains were germinated for 12, 16, 20 and 24 h at temperature of 32°C.The germinated amaranth grains were dried in a tray drier at 45ºC for 18 hr time and ground for further analyses. The higher protein and fibre was noticed at 16 hr germinated amaranth grains as compare to ungerminated grains. Germination period (12, 16, 18 & 20) decreased the fat content of amaranth grains whereas, no change was found in ash content of germinated grains as compare to control. The bulk densities of germinated flours were lower compared to the ungerminated flour. Water absorption index was highest at 16 hrs. germination, whereas water solubility index was lowest at this germination time .

Keywords: Germination, Amaranth, bulk density, water absorption index, water solubility index.

1. Introduction

Amaranthus species, commonly known as amaranth or pigweed, is one of the alternative crops grows suitably in temperate climates (Bavec and Bavec, 2006). At the

present time 60 species of Amaranthus are documented, among these *Amaranthus cruentus*, *Amaranthus hypocondricus*, and *Amaranthus caudatus* are the main grain-producing species. In India, the entire Himalayan region, and some extent in the states of Gujarat, Maharashtra, Karnataka and eastern parts of Uttar Pradesh is used Amaranth as an important ingredient in food. Grains or young leaves of Amaranth could completely or partially substitute to common ingredients, so the crop could be potentially exploited as an ingredient in food formulation in form of flour, flakes, sprouts, grain undergoing fermentation, popping, malting, extrusion cooking, nixtimisation, and special compounds isolation (Mlakar et al., 2010).

Amaranth is a pseudo-cereal multipurpose crop with good potential for exploitation as grain, vegetable and fodder .The nutritional value of pseudo cereals is mainly connected to their proteins. The protein content of pseudo-cereals and minor cereals has been investigated and it has been demonstrated that is higher with respect to wheat. It contains a high concentration of lysine, 0.73% to 0.84%, of the total protein, an essential amino acid lacking in all of the main cereal crops (Becker et al., 1981; Bressani, 1994). It is also relatively rich in the sulfur-containing amino acids, which are normally limiting in the pulse crops (Bressani et al., 1987). Amaranth is an excellent source of iron and vitamin β carotene so; it can help in reducing iron and vitamin A deficiency. The higher amount of folic acid in amaranth can help in increasing the blood haemoglobin.

Germination is an inexpensive and effective technology for improving the nutritive availability and diminishing the anti – nutritional factors in cereals (yuan et al., 2005). The breakdown of seed reserves, carbohydrates, and in some cases of protein take place during germination (Vanderstoep 1981).Amaranth grain is good source of high quality protein (Senft 1979). Therefore it is important to know the proximate composition and its other physico – chemical properties of amaranth during germination. This study examined the effect of germination duration (12 h, 16h, 20h & 24h) on the proximate composition and physico - chemical composition of amaranth flour.

2. Materials and Methods

2.1 Raw materials

Amaranth grains were purchased from Vivekananda Parvitya Krishi Anusandhan Sansthan (Almora). The aim was so that the grains could be bought from the same source and same variety for consistency in the nutritional value.

2.2 Germination of Amaranth grains

The grains were cleaned & soaked in distilled water for 2 hr, after soaking grains were germinated at a pilot scale by layering them over a moist muslin cloth continuously watered by capillarity in a seed germinator (Macro scientific works pvt.ltd.India) for 12 h, 16h, 20h & 24h at 32°C and 90% relative humidity. Grains were then dried in

tray drier at 45 ˚C for 18 hr and milled in to fine flour and pass through 20 mesh and stored at 4˚C until used for further analysis.

Table 1

Sample no.	Germination time	Germination temp.
1	12	32˚C
2	16	32˚C
3	20	32˚C
4	24	32˚C

2.3 Chemical composition

The chemical composition of the flours (Raw & Germinated) including the moisture, fat, ash, fiber, and protein content, were determined by the method described in AOAC (1995).

2.4 Evaluation for water absorption index (WAI) and water solubility index (WSI)

WAI and WSI were determined according to the method developed for cereals (Anderson et al., 1969; Yagci and Gogus, 2008; Stojceska et al., 2008). The ground flour were suspended in water at room temperature for 30 min, gently stirred during this period, and then centrifuged at 3000 g for 15 min. The supernatants were decanted into an evaporating dish of known weight. The WAI was the weight of gel obtained after removal of the supernatant per unit weight of original dry solids. The WSI was the weight of dry solids in the supernatant expressed as a percentage of the original weight of sample.

2.5 Bulk density (BD)

Bulk density was determined by the method of Wang and Kinsella (1976). Ten grams of the tested flour were placed in a 25 ml graduated cylinder and packed by gentle tapping of the cylinder on a bench top, ten times, from a height of 5–8 cm. The final volume of the test flour was measured and expressed as g/ml.

2.6 Statistical Analysis

Data were assessed by Duncan's multiple range test (Duncan's, 1955) using statistical 7(statistical _soft, TUSA,USA) statistical software packages at $P<0.05$ was used to determine ,which means are significant different.

3. Result and Discussion

Table 2 shows the proximate composition of germinated flours. There was no significant difference was found in ash content of germinated flour as compare to control or ungerminated flour. Ruiz and Bressani (1990) also reported similar ash

content in ungerminated amaranth grain is 3.0 % and they found there were no changes in ash content with respect to germination time.

Table 2: Proximate composition of germinated amaranth flour.

Treatment	Ash	Fat	Fibre	Protein
Control	3.03a	6.76a	4.40c	15.06c
12 h,32 ºC	3.00a	6.06b	5.36b	15.23c
16 h,32 ºC	2.96a	5.0c	7.06a	15.96a
20 h, 32 ºC	2.86a	5.0c	6.83a	15.63b
24 h, 32 ºC	2.96a	4.56c	6.96a	15.56b

Values are means with the same superscript letter in a row are not significantly different ($p < 0.05$), n= 3

Fat content was affected by germination period (12 h, 16 h). Fat content value for 12h and 16 h germinated flour was 6.06% and 5.0%, respectively (table 2), which was significantly ($P < 0.05$) lower than control or ungerminated flour (6.76%). Similar observations of lowered fat content on germination are reported by for broccoli seeds (Taraseviciene, 2009). After 16 h, germination there was no significant change was found in fat content of germinated flour up to 24 h.

The fibre content of control and germinated amaranth grain flour was presented in (table 2).Results indicated that the fibre content increased significantly ($P < 0.05$) with increasing germination time, reaching a maximum on the 16 h germination (table 2).Working with broccoli seeds, Taraseviciene (2009) also found that crude fibre content was increased with increasing germination time.

Germination significantly ($P < 0.05$) increased the protein content of amaranth flour; the 16 h of germination had the maximum value (Table 2). Mbithi-mwikya et al. (2000) reported that there was a slight but significant increase in protein content of finger millet during germination. They attributed the increases in protein content to be due to dry matter loss particularly through carbohydrates through respiration causing an apparent increase in other nutrients such as proteins.

Table 3: Physico- chemical properties of germinated amaranth flour.

Treatment	WAI	WSI	BD
Control	3.45b	5.18a	0.61a
12 h,32 ºC	3.43b	5.20a	0.59b
16 h,32 ºC	3.82a	4.60b	0.56c
20 h, 32 ºC	3.05c	5.30a	0.54d
24 h, 32 ºC	3.06c	5.29a	0.53e

Values are means with the same superscript letter in a row are not significantly different ($p < 0.05$), n= 3

WAI= Water absorption index; WSI= Water solubility index; BD= Bulk density.

The water absorption index (WAI) of amaranth flour, significantly ($P < 0.05$) increased with germination. The 16 hr germinated sample had the maximum value of water absorption index (Table 3). Other studies also report that the water absorption capacities of cowpea, green gram, lentil and bengal gram are improved by germination (Ghavidel and Prakash, 2006, Padmashree et al., 1987 and Rosario and Flores, 1981). An increase of WAI on germination could be attributed to an increase in protein content and change in the quality of protein upon germination and also breakdown of polysaccharide molecules; hence the sites for interaction with water and holding water would be increased (Gamel et al. 2006).

The water solubility index of control and germinated amaranth grain flour was presented in (table 3).Results indicated that the water solubility index decreased significantly ($P < 0.05$) at 16 h germination time as compare to control. Whereas, significantly increased was shown in WSI at 20 h but there was no significant change was found at 24 h germination.

Control or ungerminated flour had the maximum bulk density (Table 3). Germination significantly ($P < 0.05$) decreased the bulk density of germinated Amaranth flour. Similar observations of lowered BD on germination are reported by Ghavidel and Prakash (2006) for green gram, cowpea, lentil and bengal gram. Desikachar (1980) expected that decreased BD would be an advantage in the preparation of weaning food formulations. Among the various traditional technologies which could be followed for the preparation of low-bulk weaning food, germination has been reported to be very useful.

References

[1] A.O.A.C (1995) Official methods of analysis (15th edn). Association of official analytical chem-ists, Washington, D. C.USA.

[2] B D Duncan (1955), multiple range and multiple F tests Biometrics, **11** pp. 1–42.

[3] D R Colmenares and R Bressani (1990), Effect of Germination on the Chemical Composition and Nutritive Value of Amaranth Grain, *Cereal Chemistry*, 67.

[4] F Bavec and M Bavec (2006), Organic Production and Use of Alternative Crops, CRC Press/Taylor and Francis, 241.

[5] H S R Desikachar (1980), Development of weaning foods with high calorie density and low hot-paste viscosity using traditional technologies, *Food Nutrition Bulletin*, **2** pp. 21–23.

[6] J C Wang and J E Kinsella (1976), Functional properties of novel proteins: Alfalfa lead proteins *Journal of Food Science*, **41**, pp. 286–290.

[7] J P Senft (1979), Protein quality of amaranth grain. In: Proc. Second Amaranth Conference. Rodale Press, Inc.: Emmaus, PA.

[8] J Vanderstoep (1981), Effect of germination on the nutritive value of legumes. *Food Technol*, 3, 83.

[9] Mu- Yuan Zhu, Ju- Fang Dong and Mao –Jun Xu (2005), Effect of germination condition on ascorbic acid level and yield of soybean sprouts. *J.Sci. Food Agric,* **85**, pp. 943 – 947.

[10] R A Anderson, H F Conway and E L Griffin (1969), Gelatinization of corn grits by roll and extrusion cooking. *Cereal Sci. Today*, **14**, pp. 4-12.

[11] R A Ghavidel and J Prakash (2006), Effect of germination and dehulling on functional properties of legume flours, *Journal of the Science of Food and Agriculture*, **86,** pp. 1189–1195.

[12] R Backer, E Wheeler, K Lorenz, A E Staffrod, O K Grosjean, A A Betschart and R M Saunder (1981), A compositional study of amaranth grain, *Journal of Food Science*, **46**:1175.

[13] R Bressani (1994), Composition and nutritional properties of amaranth. In: Paredes-López O. (ed.): Amaranth: Biology, Chemistry and Technology. CRC Press: 185–205.

[14] R Bressani, J M González, J Zúñiga, M Breuner and L G Elías (1987), Yield, selected chemical composition and nutritive value of 14 selections of amaranth grain representing four species. *Journal of Science, Food and Agriculture*, **38**, pp.347-356.

[15] S Mbithi-mwikya, J V Camp and A Huyghebaert (2000), Development of a Fingermillet based Complementary Food for children. PhD Thesis. Ghent University. Belgium.

[16] S Yagci and F Gogus (2008), Response surface methodology for evaluation of physical and functional properties of extruded snack. foods developed from food-by-products, J. Food Eng, **86**,pp. 122-132.

[17] T H Gamel, J P Linssen, A S Mesallam, A A Damir and L A Shekib (2006), Seed treatment affect functional and antinutritional properties of amaranth flours, *Journal of the Science of Food and Agriculture*, **86,** pp. 1095–1102.

[18] T S Padmashree, L Vijayalakshmi and S Puttaraj (1987), Effect of traditional processing on the functional properties of Cowpea (Vigna unguiculata) flour, *Journal of Food Science and Technology*, **24**, pp. 221–225.

[19] V Stojceska, P Ainsworth, A Plunkett, E Ibanoglu and S Ibanoglu (2008), Cauliflower by-products as a new source of dietary fibre, antioxidants and proteins in cereal based ready-to-eat expanded snacks. *J. Food Eng*, **87**, pp.554-563.

[20] Z Taraseviciene , H Danilcenk , E Jariene , A Paulauskiene and M Gajewski (2009), Changes in Some Chemical Components During Germination of Broccoli Seeds, *Not. Bot. Hort. Agrobot. Cluj*, **37**, pp. 173-176.