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Effect of germination on chemical composition of two wheat cultivars

Thuraeya A.A. Abbas

Dept. of Biology, College of Science, Al-Mustansirya University, Baghdad, Iraq.

Abstract

Two wheat cultivars (Ajeeba and Maxipak) were germinated for 6 days in the presence of light. Samples were taken at 24hr. intervals. Analyses of the meals showed an increase in protein, fat, ash, crude fiber and decrease in dry matter and carbohydrate content. Amino acids content of un-germinated and germinated samples were determined. Lysine content increased during germination, whilst glutamic acid and proline decreased, other amino acids, such as aspartic acid, threonine, histidine and arginine were affected by sprouting.

Keywords: Wheat cultivars, Germination, Chemical analysis, Amino acids.

Introduction

With the continued increase in the world population and pressure on land use, man has been greatly concerned with quantity as well as the quality of food. If people are to be fed, it will be from improved plant and animal resources (Kylin and McGready, 1975; King and Puwastin, 1987; Nnanna and Dixon–Phillips, 1990; Alwan *et al.*, 2007).

Accordingly, new food processing technologies can provide alternative for improving the nutritional quality of food of plant sources (Wittwer, 1976; Ahmed and Fields, 1987). Germination generally increases the nutritive value of seeds (Everson *et al.*, 1944; Mattingly and Bird, 1945; Desikachar and Dc, 1950). Germination is an economical and promising way of improving nutritional characteristics of cereal. This process does not need expensive equipment or particular expertise, and can provide results in a short period of time (Chen, 1970; Marco *et al.*, 1970). Sprouted wheat, for example, is being promoted not only for traditional use as a fresh vegetable but also as a flour. Although in a natural foods book, signify that the sprouting of wheat has been found to improve protein quality (Elwood, 1964). Amino acid composition of various cereal grains as affected by germination has been the subject of several investigations (Dalby and Tsai, 1980; Wu and Wall, 1980; Wu, 1982; Wu, 1983; Bau *et al.*, 1997). With the emphasis on the changes in essential amino acids, especially lysine. The change in the amino acid, pattern in germinated barley seeds was investigated by (Folks and Yemm, 1958; Chandrasiri *et al.*, 1990). They found that glutamic acid and proline content were decreased whereas alanine, glycine, lysine and arginine were increased.

The objectives of this work were (1) To examine the potential for improving nutritional quality of wheat by sprouting and (2) To detect for differences between Ajeeba (Iraqi local cultivar) and Maxipak during germination.

Materials and Methods

Seeds of two wheat cultivars Ajeeba (Iraqi local cultivar) and Maxipak were cleaned and soaked in distilled water for 6h. After soaking, the seeds were placed in growth chamber at 30°C for 6 days. Samples were taken at 24 hours intervals for 6 days and dried at 60°C for 48hr. for constant weight and fine grinding before subjecting to chemical analysis. Dry matter, lipid, ash, crude protein and crude fiber content were determined on wheat seeds and sprouts according to the standard methods (AOAC, 1980). Amino acid analysis were performed on a LKB 4151 automatic amino acid analyzer. An electronic integrator was used to process the data. The effect of germination on the composition was determined by split - plot design. All analyses were performed in 4 replication, with the exception of amino acid analysis, which was done in duplication (SAS, 2001).

Results and Discussion

Data presented in table (1) shows that there was a significant reduction in dry matter content, reaching its minimum 6 days after germination. This could be attributed to high water absorption

which has led to un increase in the fresh weight of seeds and sprouts. Protein, lipid, ash, crude fiber and carbohydrate at different stages of germination are also shown in Table (1).

The increases in protein, lipid, ash and crude fiber contents of sprouted wheat can be accounted for mostly by the loss in dry matter during germination. Protein content was increased by 39% and 30% for Ajeeba and maxipak, respectively. These results agree with those of (Dalby and Tsai, 1980; Lemar and Swanson, 1975; Ranhotra *et al.*, 1977) Crude fiber content of wheat seeds showed a high significant ascending relationship with germination period. The content of crude fiber in var. Ajeeba was increased from2.76% to 15.40% in germinated seeds after 6 days, while that in var. Maxipak increased from 2.89% to 17.03% after 6 days of germination.

Data presented in Table (1) shows that there was a significant increase in lipid content reaching its maximum after 6 days of germination. Ash content in both varieties (Ajeeba and Maxipak) was also found to be increased during germination. On the other hand, the percentage of carbohydrates showed gradual. and significant decrease during germination period, reaching its minimal value after 6 days. This could be attributed to the degradation of polysaccharides under the effect amylase and phosphorylase enzymes as part of the respiratory metabolism (Folks and Yemm, 1958)

The nutritive value of a dietary protein is dependent on its essential amino acid composition (Wu, 1982). Data on amino acids of germinated and ingeminated wheat seeds are shown in Table (2). The same amino acids were present in both ingeminated and germinated seeds. Greater changes were found in var. Maxipak. The amino acid lysine showed the highest increase which amounted to 48% in var. Maxipak and 17% in var. Ajeeba after a germination time of 6 days. In the germinated material of both varieties the content of glutamic acid, proline in the hydrolyzed protein were markedly reduced. Aspartic acid showed greater increase, amounting to 127% and 141% of the original content. Other amino acids which increased during sprouting were histidine and argentine.

Germination should improve the nutritional value of the meal by increasing lysine, the main limiting amino acid of wheat seeds. The changes in lysine content of wheat seeds during germination are in agreement with those previously reported by (Singh and frank, 1986; Alexander *et al.*, 1994).

The nutritional benefits to be accrued from baking with sprouted flour will be lessened by the necessity to blend sprouted flour with un spouted flour in order to obtain a good quality bread. The use of 100% sprouted wheat flour yielded low loaf volume.

In baking tests conducted by the Western Wheat Quality Laboratory (1974). However, home baking tests indicate that good loaf volume and churn in texture are obtained by blending sprouted wheat with unsprouted whole wheat flour in the ratio 1:4 volume. The sprouted wheat can be used as vegetable or salad or can be dried and ground to flour in more traditional food uses.

Table (1): Chemical constituents of two wheat cultivar during germination (% on dry matter basis)

Germination	Dry matter		Crude protein		Crude fiber		Ash		Lipids		carbohydrates	
(days)	A	M	A	M	A	M	A	M	A	M	A	M
0	92.92	92.76	14.8	13.76	2.76	2.89	1.62	1.71	1.66	1.69	81.92	82.84
1	51.90	52.43	15.33	13.79	4.04	4.04	1.62	1.71	1.71	1.69	81.34	82.80
2	34.21	32.41	15.69	14.6	4.93	4.19	1.72	1.73	1.86	2.00	80.71	81.66
3	19.48	17.21	16.91	15.42	7.61	6.86	2.01	2.29	2.36	2.16	78.71	80.29
4	17.10	14.51	17.65	15.85	9.16	9.65	2.31	2.61	2.36	2.29	77.73	79.24
5	10.93	12.26	17.97	16.75	12.58	13.95	2.74	2.68	3.30	2.71	75.98	77.85
6	9.52	11.57	20.53	17.87	15.40	17.03	3.05	2.89	3.80	3.38	72.60	75.85
Variety	0.272		0.065		0.268		0.136		0.046		0.09	
L.S.D. Germination at 5%	0.142		0.142		0.42		0.078		0.10		0.36	
var. x ger.	1.746		0.020		0.598		0.078		0.45		0.509	
L.S.D. Variety	0.50		0.116		0.490		0.251		0.084		0.176	
at 1% Germination	0.19		0.19		0.56		0.105		0.13		0.48	
var. x ger.	2.33		0.027		0.802		0.104		0.606		0.68	

A: Ajeeba, M: Mexipak

Table (2): Amino acid composition of wheat seeds (g/I00gm protein)

Amino acid	Ajeeba				Maxipak			
	Days of germination							
	0	2	4	6	0	2	4	6
Lysine	2.70	2.99	2.83	3.16	2.63	3.15	3.34	3.97
Threonine	2.77	2.74	2.94	2.92	2.61	2.67	3.02	3.07
Serine	4.59	3.95	3.56	3.21	3.99	3.90	3.65	3.30
Glutamic acid	29.39	23.26	15.01	8.52	25.65	22.8	15.39	9.84
Proline	I0.94	8.92	5.04	4.04	10.39	9.04	6.6 8	4.70
Glycine	4.12	3.69	3.79	3.65	3.92	3.97	4.03	3.86
Alanine	3.51.	3.82	4.4I	4.38	3.34	3.90	4.41	4.47
Cystine Valine	8.78	6.24	6.5I	6.I3	8.35	7.32	6.94	6.09
Methionine	0.60	0.25	0.33	0.38	0.50	0.47	0.44	0.50
Isoleucine	3.85	3.31	3.34	3.16	3.56	3.42	3.53	3.3
Leucine	7.22	6.50	6111	5.45	6.61	6.50	6.49	6.04
Tyrosine	1.89	1.65	1.8I	1.4	1.52	1.71	I.76	1.67
Phenyl alanine	4.86	4.27	3.85	3.31	4.28	4.10	4.03	3.52
Histidine	2.29	2.16	1.92	1.80	0.65	2.05	2.08	3.97
Aspartic acid	5.20	5.60	11.5	12.56	4.72	5.61	9.4	10.74
Arginine	4.79	4.0I	3.79	4.87	4.50	4.45	4.60	5.59

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