ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Some Qualitative Properties of Functional Cake Containing Flaxseed Powder.

Zaker Aghakeshipour[1*], and Ghila Aghakeshipour [2].

[1]Expert Directorate General Standard of Alborz Province, Karaj, Iran.
[2]Food Science and Engineering graduate student at Tabriz University, Tabriz, Iran.

ABSTRACT

Flaxseed is a nutritional supplement which can be effective in preventing some disorders such as cancer and cardiovascular diseases. Bakery products such as cake are highly consumed throughout the world. Cake is produced using 25-100% fat. Long-term consumption of this product can lead to obesity and associated problems, due to its high calorie and high amount of sugar and fat in the formulation. Therefore, regarding the nutritional properties of this product, improvement of quality seems essential. The aim of functional cake production containing flaxseed is to produce a new product with high nutritional values and health benefits. In this study the effect of flaxseed addition as a rich source of tocopherol on cake properties was investigated. Flaxseed powder was added in 5%, 10 % and 15% amounts (based on flour weight) and qualitative properties including tocopherol were assessed**.** The results indicated that by increasing the amount of flaxseed, tocopherol amount increased. It was observed that the sample containing15% flaxseed had more tocopherol compared to control. It was also found out that by increasing the percentage of flax powder, oil content and linoleic acid and tocopherols samples increased and the nutritional value of the product improved.
Keywords: functional food, cake, flaxseed, fatty acid, tocopherol

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Bakery products are among cereal derived products which are widely used throughout the world. These products maintain a major proportion in families' consumption basket due to their low price and high nutritional values [1]. Cake is a product derived from wheat flour, which is highly consumed and important [2]. Today essential fatty acids and fiber deficiencies have become obvious. Essential fatty acids consist of omega 3 and omega 6. Nowadays omega 3 is more needed in diet due to its deficiency. Essential fatty acids protect against cardiovascular, defense and neurological systems [3]. Fiber plays an important role in preventing disorders such as diabetics, cardiovascular diseases and cancer. There has been an increasing effort to compensate this deficiency by functional food production, which contains these substances. Cake is one of the best choices for enrichment with functional ingredients such as essential fatty acids and fibers.

Flaxseed is a member of the genus Linum in the family Linaceae. It has been cultivated since 5000 B.C. for its health benefits and special oil. Flaxseed contains 40-45% oil, high levels of linolenic acid (belonging to essential omega 3 fatty acids) antioxidants and fiber [4-5]. Flaxseed has been used in many food formulations. Chen et al. (1994) studied flaxseed stability in different products such as cakes [6]. Koca and Anil (2007) investigated rheological characteristics of wheat flour and flaxseed powder mixture paste [7]. Mentes et al. (2008) studied the effect of flaxseed powder on bread quality, staling, Gamma-tocopherols and unsaturated fatty acids [4]. Many studies regarding flaxseed effect on human health proved its important role in preventing different diseases [8].

Considering high cake consumption and flaxseed nutritional values, the effect of flaxseed powder addition in different amounts on cake's qualitative characteristics was studied.

MATERIAL AND METHODS

Materials

Flaxseed and salt were supplied from Tabriz city local markets. Wheat Flour was provided by Zar Flour Company. Chemical agents including potassium and sodium hydroxide, phenolphthalein indicator, Sodium thiosolphate, starch indicator, acetic acid, ethanol, chloroform, NaOH, Isopropanol and Hcl were purchased from Merck (Germany) company.

Methods

Cake production

Cake was produced according to sugar- batter method peighambadoust (2007) [2]. Wheat grains were cleaned and then they were fed into mill. Milling was performed in several stages due to sensitivity of oil. Sieving was done by a 0.6 mm sieve after each step. The remaining particles re-entered the mill from above the sieve and they were milled. The final product was stored at 180C until cake production. First oil and sugar were mixed and after 10 minutes a cream was obtained. Next egg was added in 4 to 5 steps. This prevents aggregate formation in batter. In the following step powdery ingredients and flour were sieved and added. Finally milk and water were poured into the mixture. Flaxseed powder was added in 5%, 10% and 15% amounts based on flour weight. Finally, 75 g of the batter was poured into the molds using a cloth funnel. Baking was performed in an oven at 200 C for 25 minutes. After cooling the samples were packaged in cellophane in order to assess the quantitative and qualitative characteristics. They were kept under ambient temperature.

Chemical Tests

Moisture and ash content were determined according to AACC 44-15 [9] and AACC 08-01[10] respectively. pH was measured according to Iran's National Standard no [11]. Acidity and peroxide number were evaluated according to Azadmard Damirchi (2010) [12]. Fatty Acids were determined by gas chromatography according to Azadmard Damirchi and Dota (2006) [13]. Tocopherol was analyzed by high performance liquid chromatography according to fathi achachelooi (2009) [14],

ISSN: 0975-8585

Statistical analysis

Statistical Analysis System (GenStat 11.1, VSN International Ltd.) was used for analysis of variance. Means were compared for significant differences (P<0.05) using Tooki's test procedure.

RESULTS AND DISCUSSION

Flaxseed powder characteristics

Table 1. Characteristics of Flaxseed powder used in cake production

Characteristic	Flaxseed powder	Component	Flaxseed powder
Moisture (%)	5.35±0.01	Palmitic Acid *(%)	6.4±0.01
Water Activity	0.64±0.02	Stearic Acid (%)	2.5±0.01
Ash (%)	3.23±0.01	Oleic Acid (%)	18.9±0.01
Fat (%)	32.3±0.03	Linoleic Acid (%)	15.2±0.01
Peroxide value (meq/Kg oil)	1.9±0.21	Linolenic Acid (%)	53.2±0.01
Acidity (mg KOH/100 **g**)	2.92±0.11	Gamma-Tocopherol **(ppm)**	90

Fatty acids are expressed as percentage of total fatty acids

Flaxseed powder characteristics are presented in table 1. In Flaxseed powder oil content is 35±0.03% and linolenic acid content is 50±0.01%. Mentes et al. (2008) [4] reported the flaxseed oil content of 24.94% 58.14% of which consisted of fatty acids. Omeh and Meza (1993) [15] reported 34-45% oil content of different flaxseed varieties, while linolenic acid content was 45-63%. Therefore, these results are consistent with previous studies.

Moisture evaluation of cake samples on the first and seventh day

Table 2: statistical analysis of effect of different flaxseed amounts on moisture percent on the first and seventh day

Average moisture percentage ±standard deviation(seventh day)	Average moisture percentage ±standard deviation(first day)	sample
20.62^{a} ± 0.11	21.53^{a} ± 0.12	control
19.54^{b} ± 0.13	20.26^{b} ± 0.10	flaxseed 5%
18.43^{c} ± 0.16	19.38^{c} ± 0.14	Flaxseed 10%
17.57^{d} ± 0.11	19.58^{d} ± 0.18	%Flaxseed 15

a, b indicate significant difference between samples (P<0.05).

According to table 2 the highest and lowest moisture content on the first day was observed for samples containing 5% and 15% flaxseed respectively. The table shows that average moisture difference between samples on the first day was significant. As presented in tables 2 the highest and lowest moisture content was assessed for samples containing 5% and 15% respectively. Sample containing 15% flaxseed is considered as the best one. This indicates that average moisture difference between samples was significant on the seventh day. The more the amount of flaxseed, the less the cake moisture is observed, which is due to high amount of fiber and water holding capacity by flaxseed. Decrease in moisture on the seventh day indicates moisture loss during time. Pohjanheimo et al. (2006) [16] came to the same results regarding effect of flaxseed on bread formulation. They evaluated the bread's characteristics (texture, odor and taste). Fatty acid content, SDG and cadmium were measured. Water holding capacity was more in flaxseed containing samples compared to control ones. Also softness in texture was reported to be more.

ISSN: 0975-8585

Ash

Table 3: statistical analysis regarding the effect of different flaxseed amounts on cake's ash content

Average ash+standard deviation	sample
0.035^{ed}±0	control
0.037^{ecb}±0	Flaxseed 5%
0.041^{cda}±0	%Flaxseed 10
0.045^{ab}±0	Flaxseed 15%

a, b indicate significant differences between samples (P<0.05).

According to table 3 the highest and lowest ash content were related to samples containing 15% and 5% respectively. According to the statistics there is a significant difference between the samples compared to the control sample. Therefore by adding flaxseed powder to cake, the amount of ash increased in comparison with control sample, which is due to high amount of fiber and ash in flaxseed. Sample containing 15% flaxseed is introduced as the best sample.

Acidity

Table 4: statistical analysis regarding the effect of different flaxseed amounts on cake's acidity on first and seventh day

Average ash standard ± percentage deviation (seventh day)	Average ash standard ± percentage deviation (first day)	sample
0.30^{efc} ± 0.02	0.26^{d} ± 0.03	control
0.33^{dfb} ± 0.02	0.33^{ac} ± 0.04	Flaxseed 5%
. 0.36^{aed} ± 0.02	0.34^{bc} ± 0.04	Flaxseed 10%
0.38^{abc} ± 0.02	0.36^{ab} ± 0.04	Flaxseed 15%

a, b indicate significant differences between samples (P<0.05).

As presented in table 4 the highest and lowest acidity numbers were related to 15% and 5% respectively on the first day. This is significant in terms of statistical analysis. Increase in acidity is owing to heating during cake production. As shown in tables 4 the least acidity was for the sample containing 5% flaxseed on the seventh day. The highest amount was for the sample containing 15% flaxseed compared to control. As observed in the table only control and sample containing 15% flaxseed are significantly different. Therefore by increasing flaxseed, the acidity increased compared to control. Increase in average acidity of the cakes on the seventh day in comparison with the first day is significant.

Peroxide number

Table 5: statistical analysis regarding effect of different flaxseed amounts on peroxide number on first and seventh day

Average of peroxide number ±standard deviation(seventh day)	Average of peroxide number ± standard deviation(first day)	Sample
1.81^{d} ± 0.05	1.56^{d} ± 0.04	Control
2.22^{c} ± 0.04	2.11^{c} ± 0.06	5% Flaxseed
2.73^{b} ± 0.05	2.58^{b} ± 0.03	10% Flaxseed
3.05^{a} ± 0.04	2.72^{a} ± 0.02	15% Flaxseed

a, b indicate significant differences between samples (P<0.05).

According to Tables 5 the least peroxide number is for 5% sample and the maximum is for 15% sample compared to control on the first day. The mean difference between samples is significant on the first day. Tables 5 show the peroxide number on the seventh day, the minimum is for 5% and maximum for 15% compared to control. The mean difference is significant on the seventh day. Increase in the average peroxide of the first day compared to the seventh day is significant. So by increasing the amount flaxseed the peroxide

number increased, which is due to the fatty acids being oxidized. The lowest peroxide number belongs to 5% sample.

Fatty acid profile

Table 6: fatty acid analysis in functional cake by addition of 15% flaxseed powder

Fatty **acid**	Concentration mg/ gr	Percentage
Palmitic acid	11.897	15.317^{c}±0.48
Palmitoleic acid	0.182	0.227^{g}±0
Stearic acid	3.224	4.098^{e}±0.01
Oleic acid	18.823	23.772^{b}±0.01
Linoleic acid	37.344	47.163^{a}±0
Linolenic acid	5.511	6.958^{d}±0
Arachidic acid	2.174	2.742^{f}±0

a, b indicate significant differences between samples (P<0.05).

According to table 6 the best cake sample is for 15% flaxseed containing sample. The highest amount of fatty acid was observed for linoleic acid, it was followed by oleic acid, palmitic acid and linoleic acid respectively. Difference in average of fatty acids is significant. The low amount of linoleic acid can be attributed to heating which causes oxidation. Oxidation decreases the linoleic acid content. As it is easily oxidized. High amount of this fatty acid may produce off- flavor and off-odor. Tocopherol is present in flaxseed which can prevent fat oxidation. Chen et. al (1994) [6] investigated flaxseed stability in bakery products like cake. In the present study stability of flaxseed grains and powder was assessed by measuring consumed oxygen and alpha linoleic acid. The results were consistent with previous studies. Application of flaxseed did not change alpha linolenic amount, but when the flaxseed is milled by heat, linoleic decreases.

Tocopherol

Table 7: statistical analysis regarding effect of different flaxseed amounts on tocopherol

Average tocopherol ± standard deviation	sample
4.33^{c} ±0.15	Control
9.33^{b} ± 0.251	5% Flaxseed
11^{ab} ± 0.2	10% Flaxseed
14.33^{a} ± 0.305	15% Flaxseed

a, b indicate significant differences between samples (P<0.05).

According to table 7, the lowest and highest amount of tocopherol was related to sample containing 5% and 15% flaxseed compared to the control group. The mean difference is significant at the 5% statistical level. The index sample is 15%. The tocopherol was significantly increased by increasing the amount of flaxseed, due to high levels of tocopherol, especially γ-tocopherol is in flaxseed oil.

CONCLUSION

The results of this study showed that flaxseed grains are rich in omega-3 essential fatty acids (linoleic acid) and gamma-tocopherol, and they can be used in functional cake manufacture. The effect of flaxseed powder was evaluated in cake formulation compared to the control. It was observed that by increasing the percentage of flax powder, oil content and linoleic acid and tocopherols contents increased and the nutritional value of the product improved.

ACKNOWLEDGMENTS

This project would have been impossible without the support of Dr. Sodeif Azadmard Damirchi, I would like to thank him for his extraordinary support in this study.

ISSN: 0975-8585

REFERENCES

[1] Shahidi F, Nasehi B, Rastgoo A. The technology of pasta products. Ferdowsi University of Mashhad, 2007, pp. 91-97.
[2] Peighambardoust S.H. Technology of cereal products. Tabriz University of Medical Sciences and Health services, 2009, pp. 200-204.
[3] Nilson SA. Stabilization of Linseed Oil for use in Aquaculture Feeds. University of Saskatchewan Saskatoon, M.C. In the Department of Animal and Poultry Science, 2008, pp.16.
[4] Mentes O, Bakkalbai E, Ercan, R. J Food Science and Technology International 2008; 14:299-306.
[5] Oomah BD, Kenaschuk EO, Mazza G. J Agricultural and Food Chemistry 1997; 45:2076-2080.
[6] Chen ZY, Ratnayake WMN, Cunnane C. J American Oil Chemists' Society 1994; 71:629-632.
[7] Koca AF, Anil M. J Food and Agriculture science 2007; 87:1172-1175.
[8] Tarpilal A, Wennberg T, Tarpila S. Current Topics in Nutraceutical Research 2005; 3(3):167-188.
[9] AACC. Approved Methods of the American Association of Cereal Chemists; 1999. Method 10-91. The Association, St Paul, MN.
[10] AOAC. Official Method ch 4-9. Sampling and analysis of commercial fats and oils; 1993. AOAC. 1993 Official Methods of Analysis of AOAC international. Maryland, USA: AOAC international.
[11] Institute of Standards and Industrial Research of Iran 2006; Cake- Specifications and test methods, ISIRI 2553, 3th. Revision.
[12] Azadmard-Damirchi S. Oils and fats chemistry and analysis. Amidi publications , Tehran, 2010, pp. 150-153
[13] Azadmard-Damirchi S, Dutta PC. J chromatography 2006; 1108: 183-187.
[14] Fathi-achachlouei B, Azadmard Damirchi S. J American oil chemists' society 2009; 86: 643-649.
[15] Oomah BD, Mazza G. J Food Chemistry 1993; 48:109-114.
[16] Pohjanheimo TA, Hakala MA, Tahvonen RL, Salminen SJ, Kallio, HP. J Food Science 2006; 71: S343-S348.