Effects of Dried Wheat Sprout Flour on Lipid Oxidation and Some Quality Characteristics of Beef Patties

Yetim H.[1], Ozturk I.[1], Sagdic O.[1] and Tornuk F.[2]

[1]Erciyes University, Engineering Faculty, Department of Food Engineering, TR-38039 Kayseri, Turkey
[2]Erciyes University, Safiye Cikrikcioglu Vocational College, TR-38039, Kayseri-Turkey

Abstract- The aim of this study was to determine efficacy of two different wheat sprout flours (WSFs) on lipid oxidation and some quality characteristics of beef patties. The wheat sprouts were dried in oven and then ground to have flours that incorporated into the recipe of beef patties in the ratios of 2, 4 and 8%. The proximate compositions (% moisture, ash, fat and protein levels), TBA, pH value and some sensory properties of the patties were determined. Additionally, the patties were stored for 6 days at 4°C and 180 days at -18 °C. The stability of the samples stored at 4°C and -18 °C were determined at the 1st, 3th and 6th day, and at the 1st, 30th, 60th, 120th and 180th days of the storage, respectively. In general, storage stabilities of the samples with wheat sprout flour were better than those of the control groups. TBA values decreased approximately 20% compared to the control group with the addition of WSFs samples at 180 th day. In sensory evaluation, panel members usually preferred the control samples containing no sprout flours, but hamburger patties with sprout flour had also quite acceptable sensory scores. The wheat sprouts caused also a statistically significant ($p<0.05$) increase in the moisture and ash contents of the patties. In conclusion, it might be suggested that wheat sprout flours could be incorporated into the some processed food materials e.g. hamburger patties as a natural additive to increase their storage stability and nutritional value.

Keywords: Patties, oxidation, wheat sprout flour, natural additive

1. INTRODUCTION

Functional foods provide essential nutrition and energy for human, and additionally they may help to reduce risk for some diseases, because of their bioactive compounds. Therefore, functional food concept gained popularity in all over the world for some decade [1]. Plant and cereals sprouts have been under evaluation as functional foods. Cereal sprouts contains more vitamins, minerals, phenolic compounds and fiber when compared to their seeds. Many researchers reported that sprouting of some plants such as broccoli, alfalfa and soy bean or grains results in the increase in some functional components like vitamins, mineral, fiber and phenolics [2-5].

Meat and meat products has important role in human nutrition that provide quality protein. In Turkey, meat and meat products are usually consumed in ground form such as hamburger patty, doner kebab and meatball [6]. Functional components like vegetable fibers, soy protein, whey powder, cereal bran have been added to the meat product to increase their functional properties [7-10]. These researches showed that these components could be used for improved functional properties of the meat products. Therefore, the aim of this study was to evaluate the effect of adding different levels of wheat sprout flour on lipid oxidation, pH, color, physicochemical and sensory properties of the beef patties.

II. MATERIALS and METHODS

A. Sprouting

In this research, the wheat cvs Demir 2000 (W1) and Konya 2002 (W2) were used as wheat species. Sprouting process was carried out according to Ozturk et al. [11], and the sprouts were dried at 55 °C in a conventional oven. All the samples were powdered by a Waring blender and screened with a 35 mesh sieve. Then this flour was added to the patty doughs.

B. Production of patties

Patty samples were produced according to the recipe of Kaya et al. [12]. The lean beef with approximately 15% fat was ground, and ground black pepper 0.5%, red pepper 0.5 %, onion 7% and salt 2% were added into the minced meat. The mix was kneaded for approximately 10 min by hand and obtained patty dough was divided into seven equal portions. The first portion was control sample. Wheat sprout flours (WSF1) and (WSF2) were

added to the other portions in the following percentages: 2%, 4% and 8% WSF1, and 2%, 4% and 8% WSF2. Each portion was kneaded for additional approximately 10 min to obtain homogeneous dough. Uncooked patties were stored either at 4ºC or -18 ºC for 0, 3 and 6 days or 30, 60, 120 and 180 days, respectively.

C. Proximate composition, pH, TBA and color

The samples were analyzed for its % moisture, protein, ash and fat contents according to the methods of AOAC International methods [13], and pH values were determined according to the methods of Sallam et al. [14]. Color of the patties was measured using a chromameter (Lovibond RT Series Reflectance Tintometer, U.K.) set on the *L*, a*, b** system [15] following the AMSA guidelines for the color measurements [16]. Lipid oxidation was measured according to perchloric acid method (4%) as outlined by Ulu [17]. The results were expressed as mg malondialdehyde (MDA)/kg sample.

D. Sensory analysis

Patty samples were cooked on a grill (Tefal, France) for 3 min, then they were served warm (around 35 ºC) in random order to an average 10 member trained panel. For the evaluation of the cooked samples, panelists were asked to evaluate surface color, texture, crispness, juiciness, taste and flavor, off flavor or odor parameters. Surface color and odor were the sensory parameters for the evaluation of raw samples. Samples were rated on a nine-point hedonic scale (1 = dislike extremely, 9 = like very much).

E. Statistical Analysis

Conventional statistical methods were used to calculate means and standard deviations. Collected data was subjected to statistical analysis using the SAS statistical software SAS [18] with two-way allocation. Significant differences between the means were further analyzed using the Duncan's Multiple Range Test.

III. RESULTS and DISCUSSION

In this study, beef patties incorporated with wheat sprout flour were stored at 4 ^{o}C for 6 days, and the changes in some quality characteristics were determined during the storage. Table 1 shows the changes of these quality characteristics of the beef patties. It is obvious from the Table 1 that the wheat sprout flour addition increased the moisture contents of beef patties significantly (P<0.05) while the contribution of the wheat sprout flour obtained from WSF2 was higher than that of the WSF1. However, increases were observed in moisture values of beef patty samples in the storage period for 3 days while they decreased again by extending the storage time to 6 days. In the meanwhile, ash, protein and total fat contents of beef patties were not influenced significantly (P>0.05) from the wheat sprout flour incorporation and effect of storage on those values was variable. pH value of the control patty sample was 5.68 at the beginning of the storage and dropped significantly (P<0.05) to 5.22 after the storage period for 6 days (Table 1). Similar trends were observed in the beef patties incorporated with WSF1. In the contrast, pH value of the beef patty sample incorporated with WSF2 at the ratio of 8% increased significantly (P<0.05) during the storage. While initial TBA value of control beef patty sample was 0.17 mg ma/kg, it reached to 0.42 mg ma/kg after the storage. Incorporation of WSF1 with beef patty resulted in significant reduction on the TBA value in the storage period. Increase of the percentage of WSF1 in the beef patty formulation caused further decrease in the TBA values (Table 1).

Table 1 exhibits the changes in some quality characteristics of beef patties incorporated with wheat sprout flour during the storage period at -18 ^{o}C for 180 days. As seen in Table 1, moisture values of beef patty samples were significantly (P<0.05) higher than that of the control sample. However, changes in moisture values of beef patties during the storage were insignificant (P>0.05). Furthermore, it is clear from the Table 1 that the most distinct relationship was observed between the TBA values and the flour addition during the storage. TBA values of beef patty samples incorporated with wheat sprout flour were significantly (P<0.05) lower as compared to control sample while significant increases occurred in the TBA values of all beef patty samples by the storage period. However, continuous increases in TBA values of beef patties were observed in the measurement intervals of the storage at -18 ^{o}C.

Table 1. Physicochemical and oxidation properties of beef patties with addition wheat sprout flour

			Storage period (day)						
			4ºC			-18 ºC			
	Sample	WSF (%)	0	3	6	30	60	120	180
Moisture (%)	Control	0	35.8±1.29	36.2±1.83	35.5±1.51	37.3±3.13	35.8±1.47	35.5±1.97	35.6±1.61
	WSF1	2	36.3±1.16	36.6±1.59	36.6±0.81	37.7±2.30	36.7±1.51	36.6±0.91	36.2±1.01
	WSF1	4	38.5±1.12	38.7±1.92	38.0±0.78	39.7±2.56	38.7±1.22	38.1±1.28	38.4±1.01
	WSF1	8	39.4±0.24	41.0±1.37	40.9±0.78	42.1±2.65	40.1±0.85	40.2±0.11	41.1±0.95
	WSF2	2	36.8±1.15	37.7±1.27	36.9±1.02	39.7±3.75	37.0±1.17	36.6±0.25	37.2±0.85
	WSF2	4	38.0±0.65	38.4±0.98	37.9±1.20	39.7±2.04	38.4±0.74	38.5±0.78	38.0±1.21
	WSF2	8	40.3±0.89	40.5±1.22	40.3±0.68	43.2±3.47	40.7±1.04	40.8±0.97	40.8±1.24
Ash (%)	Control	0	2.98±0.00	2.91±0.01	2.95±0.08	2.90±0.03	2.83±0.04	2.90±0.00	2.91±0.00
	WSF1	2	3.01±0.01	2.93±0.00	2.95±0.04	2.93±0.02	2.80±0.09	2.93±0.02	2.91±0.02
	WSF1	4	2.93±0.01	2.99±0.00	3.01±0.03	2.87±0.01	2.93±0.04	2.93±0.02	2.93±0.06
	WSF1	8	3.04±0.01	2.99±0.03	3.07±0.00	2.90±0.04	3.00±0.03	2.93±0.01	2.93±0.04
	WSF2	2	2.93±0.04	3.05±0.08	2.92±0.01	2.90±0.00	2.93±0.02	2.85±0.12	2.94±0.03
	WSF2	4	2.99±0.02	2.96±0.03	2.97±0.05	2.91±0.02	2.94±0.01	2.95±0.04	2.96±0.05
	WSF2	8	2.95±0.06	2.98±0.00	3.03±0.00	2.97±0.01	2.95±0.04	2.93±0.06	2.97±0.00
Fatty (%)	Control	0	13.3±1.53	12.6±0.85	13.1±2.48	13.2±1.54	13.5±1.82	13.2±1.52	13.2±0.20
	WSF1	2	12.9±1.69	11.8±1.19	13.2±1.66	12.1±1.56	12.8±2.20	12.9±1.48	12.7±1.24
	WSF1	4	13.8±0.91	13.4±1.04	12.8±1.15	13.2±1.29	13.7±1.24	13.6±1.02	13.1±0.33
	WSF1	8	13.4±1.56	12.8±1.49	12.5±0.28	12.7±0.01	13.2±0.62	13.1±0.57	13.2±0.54
	WSF2	2	12.2±0.96	12.8±0.50	13.7±1.15	13.3±0.71	12.9±1.32	13.1±0.71	13.9±1.37
	WSF2	4	9.05±3.84	11.5±0.69	14.0±0.42	13.1±0.62	13.3±0.55	13.8±1.01	13.8±0.72
	WSF2	8	10.7±1.04	10.8±0.26	10.5±1.23	12.8±0.72	12.7±1.19	13.1±1.20	13.0±0.85
Protein (%)	Control	0	17.8±0.10	17.7±0.99	16.9±0.14	18.2±1.13	18.7±0.30	17.7±0.26	17.3±0.31
	WSF1	2	16.1±0.51	17.7±0.72	17.2±0.67	18.4±0.24	17.7±0.25	17.0±0.68	17.4±0.71
	WSF1	4	16.8±0.60	16.8±0.52	17.5±0.16	18.1±0.17	17.7±0.10	18.0±0.61	16.8±0.29
	WSF1	8	17.0±0.04	17.9±0.29	17.2±0.71	17.3±0.08	17.6±0.25	17.1±0.03	17.1±0.43
	WSF2	2	17.2±0.56	17.7±0.03	18.0±0.88	17.5±0.00	17.3±0.29	16.4±0.11	17.7±0.07
	WSF2	4	17.0±0.76	17.1±0.81	17.5±0.59	17.8±0.52	17.7±0.15	17.7±0.32	17.8±0.46
	WSF2	8	16.3±0.38	16.3±0.35	17.9±0.12	17.4±0.60	17.4±0.09	16.2±0.35	16.5±0.57
pH	Control	0	5.68±0.04	5.71±0.05	5.22±0.06	5.75±0.00	5.67±0.00	5.68±0.01	5.53±0.04
	WSF1	2	5.66±0.08	5.69±0.08	5.36±0.00	5.77±0.00	5.71±0.05	5.71±0.01	5.52±0.08
	WSF1	4	5.62±0.08	5.71±0.09	5.59±0.10	5.77±0.00	5.73±0.04	5.73±0.00	5.57±0.05
	WSF1	8	5.63±0.10	5.70±0.07	5.62±0.10	5.77±0.01	5.72±0.07	5.72±0.02	5.57±0.06
	WSF2	2	5.65±0.07	5.72±0.07	5.35±0.23	5.79±0.01	5.76±0.03	5.73±0.02	5.62±0.03
	WSF2	4	5.66±0.08	5.72±0.09	5.38±0.08	5.80±0.01	5.77±0.01	5.70±0.01	5.66±0.02
	WSF2	8	5.67±0.10	5.73±0.09	5.76±0.01	5.80±0.00	5.80±0.01	5.69±0.00	5.63±0.04
TBA (mg ma/kg)	Control	0	0.17±0.01	0.23±0.03	0.42±0.01	0.33±0.02	0.41±0.05	0.83±0.01	1.09±0.18
	WSF1	2	0.17±0.01	0.20±0.01	0.37±0.04	0.18±0.01	0.30±0.04	0.69±0.15	0.86±0.01
	WSF1	4	0.16±0.03	0.22±0.04	0.26±0.01	0.20±0.04	0.26±0.03	0.53±0.07	0.94±0.18
	WSF1	8	0.16±0.01	0.22±0.16	0.17±0.02	0.25±0.01	0.34±0.06	0.61±0.03	0.91±0.03
	WSF2	2	0.17±0.01	0.31±0.02	0.38±0.01	0.38±0.01	0.48±0.01	0.61±0.27	0.93±0.03
	WSF2	4	0.15±0.01	0.25±0.01	0.34±0.02	0.21±0.04	0.25±0.01	0.72±0.01	0.89±0.12
	WSF2	8	0.16±0.02	0.32±0.04	0.37±0.01	0.35±0.02	0.72±0.08	0.75±0.03	0.95±0.01

Control: without sprout flour patties, ma: malondialdehyde, TBA: Thiobarbituric acid, ±: Standard deviation , WSF1:Demir wheat sprout flour, WSF2:Konya wheat sprout flour, WSF: Wheat Sprout flour,

At the beginning of the storage, L^*, a^* and b^* values of control samples were 43.5, 3.78 and 9.64, respectively. Those values were significantly ($P<0.05$) different from the beef patty samples incorporated with wheat sprout flours. Wheat sprout flour addition resulted in decreases in L^* and b^* values of beef patty samples while it positively affected a^* value.

Control sample had the highest sensorial scores as compared to the beef patty samples with the sprout flours. Increasing the percentage of flour in the patty formulation caused further decreases in the sensorial scores. However, dramatic decreases were not generally observed in the general acceptability of beef patties during the storage period (The data was not presented). The lowest general acceptability score (4.83) was determined in the beef patty sample incorporated with WSF2 in the ratio of 8%.

In conclusion, it might be suggested that wheat sprout flours could be incorporated into the some processed food materials as a natural additive to increase their storage stability and to gain further health benefits.

ACKNOWLEDGMENT

The financial support from the Scientific Researches Project Unit of Erciyes University is greatly acknowledged.

REFERENCES

1. De Roos, MN (2004) The potential and limits of functional foods in preventing cardiovascular disease. Arnoldi A. (Ed.),Functional Foods, Cardiovascular Disease and Diabetes, Woodhead Publishing Limited, Cambridge, England.
2. Hamilton MJ, Vanderstoep J (1979) Germination and Nutrient Composition of Alfalfa Seeds. J Food Sci 44: 443-445
3. Yang F, Basu TK, Ooraikul B (2001) Studies on Germination Condition and Antioxidant Contents of Wheat Grain. Int J Food Sci Nutr 52: 319-330
4. Plaza L, Ancos B, Cano MP (2003) Nutritional and Health-Related Compounds in Sprouts and Seeds of Soybean (Glycine max), Wheat (*Triticum aestivum* L.) and Alfalfa (*Medicago sativa*) Treated By a New Drying Method. Eur Food Res Technol 216:138-144
5. Lin PY, Lai HM (2006) Bioactive Compounds in Legumes and Their Germinated Products. J Agric Food Chem 54: 3807-3814
6. Velioglu HM, Velioglu SD, Boyaci IH, et al. (2010) Investigating the effects of ingredient levels on physical quality properties of cooked hamburger patties using response surface methodology and image processing technology. Meat Sci 84:477–483
7. Serdaroglu M (2006) Improving Low Fat Meatball Characteristics by Adding Whey Powder. Meat Sci 72:155-163,.
8. Yilmaz I (2004) Effects of Rye Bran Addition on Fatty Acid Composition and Quality Characteristics of Low-fat Meatballs. Meat Sci, 67:245-249
9. Yılmaz I (2005) Physicochemical and Sensory Characteristics of Low fat Meatballs with Added Wheat Bran. J Food Eng 69:369-373
10. Yilmaz I, Daglioglu O (2003) The Effect of Replacing Fat with Oat Bran on Fatty Acid Composition and Physicochemical Properties of Meatballs. Meat Sci 65:819-823
11. Ozturk I, Sagdic O, Hayta M, Yetim H (2011) Alteration in α-tocopherol, Some Minerals and Fatty Acid Contents of the Wheat Through Sprouting. Chem of Nat Compd (in press)
12. Kaya M, Yetim H, Kotancilar G et al. (1988) Degisik Seviyelerde Yagsız Soya Unu Katılan Taze ve Depolanmıs Hamburgerlerin Clostridium Perfiringes ve Diger Bazı Mikroorganizma Duzeyleri. Gıda 13:129-135
13. AOAC (2000). Analyses code 990.03. In Official Methods of Analysis of AOAC International. 17th edn. 1(4), Washington DC: Association of Official Analytical Chemists
14. Sallam,KI, Ishioroshi M, Samejima K (2004). Antioxidant and antimicrobial effects of garlic in chicken sausage. LWT-Food Sci Technol 37:849-855
15. Mitsumoto M, O'Grady MN, Kerry JP, et al. (2005) Addition of tea catechins and vitamin C on sensory evaluation, colour and lipid stability during chilled storage in cooked or raw beef and chicken patties. Meat Sci 69:773-779
16. Hunt MC, Acton JC, Benedict RC, et al. (1991) Guidelines for meat color evaluation. Chicago: American Meat Science Association and National Live Stock and Meat Board.
17. Ulu H (2004) Evaluation of Three 2-Thiobarbuturic acid Methods for the Measurement of Lipid Oxidation in Various Meats and Meat Products. Meat Sci 67:683-687
18. SAS (2000). SAS/STAT User's Guide (Version 8.2), SAS Institute Inc., Cary, NC., New York.