International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2014): 5.611

Sensory and Quality Attributes of Fortified Fiber Rich Cheese Bread

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Abstract: ***The performance of 10, 20 and 30% oats flour composite bread was carried out by evaluating the color, aroma, texture, acceptability and buying preference. The samples were served to semi-trained panelists. The result showed that bread baked with 10 and 30% composite flour were not significantly different in all sensory attributes, acceptability and readiness to buy from the control. However, bread baked from30% composite flour showed low mean scores to all the attributes. There was a tendency for bread baked with 10 and 20% composite flour to be rated higher than the control especially in flavor, acceptability and desire to buy. Uniformity in the scores between all labeled and unlabeled samples was also observed. Values obtained for proximate composition of oats composite bread samples were comparable to those obtained for whole wheat bread. Adoption of wheat/oats flour for bread making is advocated in this work as an alternative to 100% wheat***

Keywords: Wheat/oats composite bread, acceptability, flour, cheese etc.

1. Introduction

The major or mandatory ingredients in bread making are flour, water and yeast the flour should have good amylase activity, the moisture content should be less than 14% and the color or appearance should be satisfactory [1]. Due to the high cost, geographical scarcity and high demand of wheat flour, efforts are been directed toward the provision of alternative source of flour [2]. The composite bread can be made by substituting 5, 10, 15, 20 And 30% plantain flour for wheat flour [3]. They have a lower summer heat requirement and greater tolerance of rain than other cereals, such as wheat, rye or barley, so are particularly important in areas with cool, wet summers, such as northwest Europe and even Iceland [4]. Oats are an annual plant, and can be planted either in autumn (for late summer harvest) or in the spring (for early autumn harvest). The oats, oat bran, and oatmeal contain a specific type of soluble fiber known as beta-glucan that lowers down cholesterol levels beta glucan [5]. In oats binds with cholesterol in bile acid in small intestine so less is reabsorbs and more is excreted from the body [6]. Celiac disease is a chronic inflammatory disorder of the small intestine resulting from the ingestion of gluten found in wheat, barley, and rye [7]. Up to 20% substitution of oats flour had no adverse sensory and organoleptic effect on bread while more development was still being expected [8]. In addition at the high temperature required for baking, cyanides are easily gotten rid of the flour [9] [10]. The present study is aimed at assessing the suitability and acceptability of oats flour composite bread through proximate and sensory evaluations [11].

2. Materials and Methods

2.1 Procurement of Raw Material

100% hard wheat flour was obtained from the mills, oats flour was obtain from local market, the oven was fabricated locally, yeast, fat, cheese, sugar, salt were obtained from the baking shop.

2.2 Preparation of Oats Flour

This process takes oat groats straight to a grinding unit (stone or hammer mill) and then over sifter screens to separate the coarse flour and final whole oat flour. The coarser flour is sent back to the grinding unit until it is ground fine enough to be whole oat flour. This method is used often in India and other countries [12].

2.3 Preparation of Composite Flours

10, 20 and 30 part by weight of oats flour were intimately mixed with 90, 80 and 70 part by weight of 100% wheat flour to obtain 10, 20 and 30% of oats/wheat composite flour respectively. They were stored in flour sack in a dried condition for use [13].

2.4 Preparation of Dough

100% wheat flour dough was prepared according to the method [14]. The composite flour dough was prepared and baked according to the method specified by the national root cropresearch institute.

2.5 Baking Process

The eight blend formulations were baked using the straight dough method [14]. The baking formula was 80% wheat flour and 20%oats flour or the blend, 36% water, 3.4% sugar, 1.6% shortening, 3% skim milk powder, 1% salt and 3% yeast [15]. all ingredients were mixed in a mixer (model a 907 d) for 5 min. the dough were fermented in bowls, covered with wet clean muslin cloth for 55 min at room temperature (29°c), punched, scaled to 250 g dough pieces, proofed in a proofing cabinet for 90 min at 30°c, 85% relative humidity and baked at 250°c for 30 min [16].

Flow Chart Of Bread Making Process

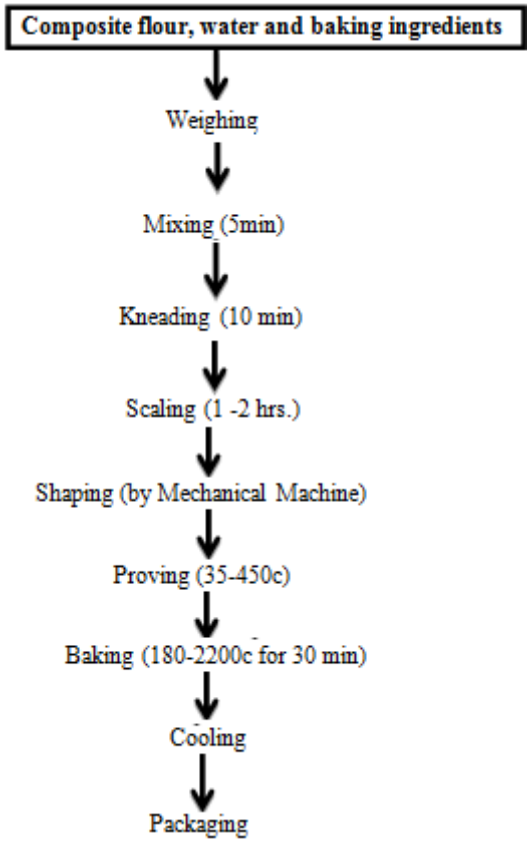

Figure 1: Flow chart for the production of functional composite bread.

2. Sensory Analysis

1 bread sample, 100% wheat, 80% composite flour bread were analyzed for moisture, energy, carbohydrate, sugar, proteins and fat contents using analytical method.The 3 samples of composite bread and the control were served to a 5 semi-trained panelists made up of a population of staff and students of college, who were familiar with the sensory attributes - taste, aroma, texture, color, of the samples. A 9-point hedonic scale was designed to measure the degree of preference of the samples. The samples were presented in identical containers, coded with 3-digit random numbers served simultaneously to ease the possibility of the panelists to re-evaluate a sample. The categories were converted to numerical scores ranging from 1 to 9, with 1 as the highest and 9 at the lowest level [17]. Necessary precautions were taken to prevent carry-over flavor during the tasting by ensuring that Panelists passed a piece of lemon fruit in their mouths or rinsed with water after each stage of sensory evaluation. Results of sensory evaluation of bread samples containing different level of oats flour substitution as compared to the control is shown in Table 1.The results of bread crust color and crumb appearance did not shown consistent pattern for all the bread samples, and there was no significant difference in the bread samples and the control sample. The darker color of the crumbs of whole wheat bread and fortified breads and biscuits have been reported by several authors [18].the brownish bread appearance could be directly related to the increase in fiber content [19].Moreover browning of the breads could also occur due to caramelization and maillard reactions, as the protein contributed by soybean flour must have reacted with sugar during the baking process [20] .The scores for texture (softness and chewiness) of the composite bread samples, increased with increase in oats flour substitution, when compared to whole wheat bread (control sample A). The bread with 20% oats flour substitution (sample B), had the best texture score. Hard crumb texture, caused by increased fiber from wheat bran substitution was reported [21]. The baking conditions (temperature and time variables); the state of the bread. Components, such as fibers, starch, protein (gluten) weather damaged or undamaged and the amounts of absorbed water during dough mixing, all contribute to the final texture of the breads [22].The incorporation of oats flour into whole-wheat bread resulted in poor flavor scores. The results showed a decrease in the scores as the whole-wheat flour was substituted with oats flour. Sample C with 30% oatsflour recording the lowest value [23].The oats content some amount of vitamin and minerals. Oats has high in water-soluble fiber, such as β-glucan, may improve cardiovascular disease risk through improvements in serum cholesterol and other intermediary risk factors [24]. . soluble fiber β-glucan is thought to be the active component for the cholesterol lowering effect of oats are high in soluble fiber and appear to reduce CVD (Cardio Vascular Diseases) risk when consumed as part of a moderate fat, balanced diet[25]. The sensory evaluation also revealed that breads with oats-flour substitution up to 20% (sample B) were overall acceptable, even though normal bread was still preferred. The baking properties of composite flour are often impaired as well as the organoleptic attributes of the products, because of the dilution of the gluten content [26].Thus, different combinations of both synthetic and organic improvers such as malt flour, vital wheat gluten and ascorbic acid can be included in dough formulation to improve the baking and sensory qualities of the products [27].

Table 1: Average of Sensory analysis Data

Sample	*Organoleptic Score**						*Remark*
	Color	*Taste*	*Flavor*	*Texture*	*Appearance*	*Overall Acceptability*	
A	7.5	7.5	8.2	8	8	8	*Like much*
B	7.7	7	7.2	7	7.5	7.7	*Like moderately*
C	7	7	6.7	6.2	6.5	6.7	*Slightly like*

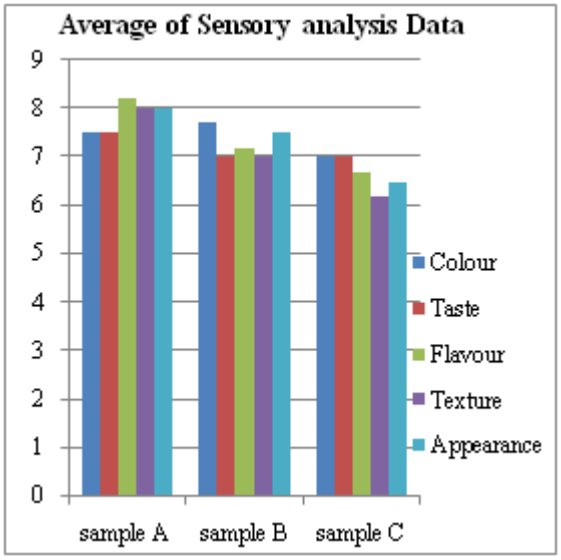

Figure 2: Graphical Chart Of Sensory Analysis Data

3. Results and Discussion

3.1 Sensory Quality Attributes

Color :- According to the sensory evaluation and the result obtained in **Table 2** it was observed that three Type of bread that is product A contain orange brownish color, product B contain dark brown color and product C contain light brown color which is does not properly baked.

Table 2: Annova of Effects on color of the Product A, Product B, and Product C.

Storage period	Colour of product A	Colour of product B	Colour of product C
0 days	8.00	9.00	8.00
1 days	9.00	8.00	7.00
2 days	8.00	8.00	7.00
3 days	9.00	9.00	8.00
4 days	9.00	9.00	8.00
F test	S	s	S
S. Ed. (±)	0.173	0.416	0.184
C.D. (P = 0.05)	0.371	1.057	0.391

Taste: -From the **Table 3**, it was observed that the acceptability of taste of product B is higher than product A and product C.

Table 3: Annova of Effects on taste of the Product A, Product B, and Product C.

Storage period	Taste of product A	Taste of product B	Taste of product C
0 days	8.00	9.00	8.00
1 days	8.00	8.00	8.00
2 days	8.00	8.00	7.00
3 days	8.00	9.00	7.00
4 days	8.00	9.00	7.00
F test	S	s	S
S. Ed. (±)	0.145	0.316	0.174
C. D. (P = 0.05)	0.354	1.022	0.382

Flavor: -From the **Table 4**, It was observed that flavor of productBis better than other two products A and C.

Table 4: Annova of Effects on flavor of the Product A, Product B, and Product C.

Storage period	Flavour of product A	Flavour of product B	Flavour of product C
0 days	7.00	7.00	8.00
1 days	7.00	8.00	7.00
2 days	8.00	8.00	9.00
3 days	8.00	7.00	8.00
4 days	8.00	8.00	7.00
F test	S	s	S
S. Ed. (±)	0.145	0.216	0.144
C. D. (P = 0.05)	0.371	1.022	0.322

Texture: -From the **Table 5,** it was observed that texture of product B is better than other two products A and C.

Table 5: Annova of Effects on Texture of the Product A, Product B and Product C.

Storage period	Texture of product A	Texture of product B	Texture of product C
0 days	8.00	9.00	8.00
1 days	7.00	8.00	7.00
2 days	7.00	8.00	7.00
3 days	8.00	7.00	8.00
4 days	8.00	8.00	7.00
F test	S	s	S
S. Ed. (±)	0.134	0.214	0.134
C. D. (P = 0.05)	0.371	1.021	0.325

Appearance: -From the **Table 6,** it was observed that texture of Product B Is Most Desirable. Product A and C is not desirable.

Table 6:-Annova of Effects on Appearance of the Product A, Product B and Product C.

Storage period	Appearance of product A	Appearance of product B	Appearance of product C
0 days	7.00	9.00	8.00
1 days	8.00	8.00	7.00
2 days	7.00	8.00	7.00
3 days	7.00	8.00	8.00
4 days	7.00	8.00	7.00
F test	S	s	S
S. Ed. (±)	0.134	0.324	0.112
C. D. (P = 0.05)	0.377	1.021	0.321

4.2 Nutritional Analysis:-

Moisture content:-The results are given in **Table No.7** moisture content of the composite breads increased with oats flour substitution by a range of 23.0 to 25.50%. Increase in moisture content has been associated with increase in fiber content. High moisture content has been associated with short shelf life of composite breads as they encourage microbial proliferation that lead to spoilage [28].

Table 7: Annova of Effects on Moisture content of the Product A, Product B and Product C.

Storage period	Moisture content of product A	Moisture content of product B	Moisture content of product C
0 days	23.50	22.00	25.00
1 days	22.50	21.50	24.00
2 days	22.00	21.40	23.50
3 days	21.50	20.00	22.00
4 days	20.00	19.50	21.50
F test	S	s	S
S. Ed. (±)	0.132	0.323	0.115
C. D. (P = 0.05)	0.379	0.021	0.323

Protein:
The results are given in **Table No.8**there was also an increase in the protein content of the composite breads with oats -flour substitution in the range of 8.13 to 12.50%. This increase is as a result of substitution of whole-wheat flour (13.90% protein). The increase in protein content of the bread as a result of the addition of oats flour. Other studies have also reported a similar increase of protein content in sorghum- oats composite [29].

Table 8:- Annova of Effects on protein of the Product A, Product B and Product C

Storage period	Protein content of product A	protein content of product B	protein content of product C
0 days	10.13	11.5	10.78
1 days	10	11.3	10.00
2 days	9.78	11.00	9.00
3 days	9.12	10.80	8.78
4 days	9.00	10.00	8.00
F test	S	s	S
S. Ed. (±)	0.238	0.322	0.137
C. D. (P = 0.05)	0.338	0.076	0.589

Carbohydrate And Energy Value :-The result are given in **Table No .9 and Table No.10** carbohydrate content and energy values were highest in sample B (50.03 g and 293.10Kcal) and lowest in sample C (43.58 g and 252 Kcal), respectively. The low carbohydrate and energy values were as result of the low fat content of the composite breads. The composite breads contained energy values in the range of 251 to 294 Kcal, and hence conformed to the (FAO/WHO, 1994) recommended minimum energy content of 1674 kJ/ 100 g.

Table 9: Annova of Effects on carbohydrate of the Product A, Product B and Product C

Storage period	carbohydrate content of product A	carbohydrate content of product B	carbohydrate content of product C
0 days	50.27	50.03	43.58
1 days	50	50	42.27
2 days	49.50	49.98	42
3 days	49.20	49.30	41.50
4 days	49.10	49.15	40
F test	S	s	S
S. Ed. (±)	0.245	0.345	0.453
C. D. (P = 0.05	0.389	0.345	0.523

Table 10: Annova of Effects on energy of the Product A, Product B and Product C

Storage period	Energy value of product A	Energy value of product B	Energy value of product C
0 days	285.60	293.10	252.10
1 days	285.40	293.5	252.5
2 days	285.30	293	252.2
3 days	285.29	292.70	251.25
4 days	285.25	292.65	251.15
F test	S	s	S
S. Ed. (±)	0.234	0.354	0.254
C. D. (P = 0.05)	0.387	0.000	0.000

4. Physico-Chemical Analysis

The results obtained from the chemical analysis and the physical properties investigated are shown in Table No 3. The increased supplementation of whole wheat flour with oats flour greatly affected the physico-chemical quality of composite bread. The proximate values for moisture and protein, were lowest in whole wheat bread (sample C), which served as control and higher in other oats flour substituted samples. The proximate values increased with increasing levels of oats flour substitutions except for carbohydrate content and energy values which showed the reverse.The result are given in **carbohydrate** content and **Energy Values** were highest in sample B (50.03 g and 293.10Kcal) and lowest in sample C (43.58 g and 252 Kcal), respectively. The low carbohydrate and energy values were as result of the low fat content of the composite breads. The composite breads contained energy values in the range of 251 to 294 Kcal, and hence conformed to the (FAO/WHO, 1994) recommended minimum energy content of 1674 kJ/ 100 g.**Moisture contents** of the composite breads increased with oats flour substitution by a range of 23.0 to 25.50%. Increase in moisture content has been associated with increase in fiber content [30]. High moisture content has been associated with short shelf life of composite breads as they encourage microbial proliferation that lead to spoilage [31]. There was also an increase in the **Protein** content of the composite breads with oats -flour substitution in the range of 8.13 to 12.50%. This increase is as a result of substitution of whole-wheat flour (13.90% protein). The increase in protein content of the bread as a result of the addition of oats flour. Other studies have also reported a similar increase of protein content in sorghum- oats composite flours [32]. The increased fiber and the lower carbohydrate content of composite breads have several health benefits, as it will aid in the digestion of the bread in the colon and reduce constipation often associated with bread produced from refined wheat flour [33]. According to well-documented studies, it is now accepted that **Dietary Fiber** plays a significant role in the prevention of several diseases such as; cardiovascular diseases, diverticulosis, constipation, irritable colon, cancer and diabetes [34]. The crude fiber contents of the composite breads, was within the recommended range of not more than 6 g dietary fiber and other non-absorbable carbohydrates per 100 g dry matter (FAO/WHO, 1994). The using whole grain raw materials and combining wheat flour with certain legumes and pseudo cereals in biscuit production resulted in improved nutritional and functional properties of the final product [34].

5. Bread Characteristics

Table 11: bread characteristics according to volume, dough expansion, specific volume.

Bread volume (cm^3)	310	280	210
Dough Expansion (cm)	460	430	405
Specific volume (cm^3/g)	0.78	0.70	0.53

Results of the physical characteristics of composite bread samples containing different levels of oats flour substitution as compared to the control is also shown in Table 11. The bread dough expansion and bread volume decreased by a range of 210 to 310 cm^3 and 9.65 to 64.52%,. The main problem of dietary fiber addition in baking is the important reduction of loaf volume and the different texture of the breads obtained [35]. Increased supplementation of wheat flour with oats flour reduced loaf volume and specific volume drastically [36].

Dietary fiber additions, in general, had pronounced effects on dough properties yielding higher water absorption, mixing tolerance and tenacity, and smaller extensibility in comparison with those obtained without fiber addition [37]. The deleterious effects of addition of fiber on dough structure and loaf volume have been suggested to be due to the dilution of gluten network, which in turn impairs gas retention rather than gas production [38].

The scores for texture (softness and chewiness) of the composite bread samples, increased with increase in oats flour substitution, when compared to whole wheat bread (control sample A). The bread with 20% oats flour substitution (sample B), had the best texture score. Hard crumb texture, caused by increased fiber from wheat bran substitution was reported [39]. The baking conditions (temperature and time variables); the state of the bread components, such as fibers, starch, protein (gluten) weather damaged or undamaged and the amounts of absorbed water during dough mixing, all contribute to the final texture of the breads [40]. The incorporation of oats flour into whole-wheat bread resulted in poor flavor scores. The results showed a decrease in the scores as the whole-wheat flour was substituted with oats flour. Sample C with 10% oats flour recording the lowest value. Most of the panelist complained of flavor and aroma from the oats flour in the composite breads [41].
The sensory evaluation also revealed that breads with oats-flour substitution up to 20% (sample B) were overall acceptable, even though normal bread was still preferred. The baking properties of composite flour are often impaired as well as the organoleptic attributes of the products, because of the dilution of the gluten content [42]. Thus, different combinations of both synthetic and organic improvers such as malt flour, vital wheat gluten and ascorbic acid can be included in dough formulation to improve the baking and sensory qualities of theproducts [43][44][45].

6. Conclusion

In conclusion, composite breads with oats flour substitutions were found to be nutritionally superior (have higher protein and fat content) to whole-wheat bread. However, the scores for organoleptic attributes like taste, aroma, texture (mouth feel), except for color were generally inferior to that of whole-wheat bread. Therefore, the oats bread had better overall acceptability scores than the whole-wheat composite breads.

The composite breads would serve as functional food because of the high fiber content. However, further research work should be focused on the phytochemical content and how to improve the organoleptic qualities and hence acceptability of oats enriched breads. Public enlightenment on the nutritional benefits of the oats supplemented functional foods would help to improve the sensory acceptability of the oats supplemented bread. There is also the need to adjust the mixing ingredients and baking techniques in order to improve the composite bread quality.

Reference

[1] E.L Adams,P.A Kroon, Williamson, G. & Morris, V.J."Characterization of heterogeneous arabinoxylans by direct imaging of individual molecules by atomic force microscopy", Journal of Carbohydrate Research, XIII (338), pp. 771–780,2003.
[2] A. Ajithkumar, A. Anderson, R. &P. Åman, "Content and molecular weight of extractable beta-glucan in American and Swedish oat samples", Journal of Agricultural and Food Chemistry, IV (53), pp. 1205–1209,2005.
[3] A.Adom, K.K. &R.H. Liu, "Antioxidant activity of grains", Journal of Agriculture land Food Chemistry, XI (50), pp. 6182–6187, 2002.
[4] C Barron, A. Surget, &X. Rouau . "Relative amounts of tissues in mature wheat (*Triticumaestivum*L.) grain and their carbohydrate and phenolic acid composition", Journal of Cereal Science, I (45), pp. 88–96,2007.
[5] P.Battling, K.Ornstein, K Minehira,J.M Schwarz. "Mechanisms of action of boldbeta-glucan in postprandial glucose metabolism in healthy men",European Journal of Clinical Nutrition, V (55), pp. 327–333,2001.
[6] R.S Bhatt, "Total and extractable ß-glucan contents of oats and their Relationship to viscosity". Journal of Cereal Science, II (15), pp. 185–192,1992.
[7] W. Bushuk, "The baking potential of Glena wheat".. *Journal of Plant Science.*, (60): pp.737–739,1980.
[8] S. Bittner, "when quinines meet amino acids: chemical, physical and Biological consequences". Amino Acids, III(30), pp. 205–224, 2006.
[9] P.A.Caballero, M. Gómez&C.M Resell. "Bread quality and dough Rheology of enzyme-supplemented wheat flour", European Food Research and Technology, V (224),pp. 525–534,2007.
[10] S.P. Cauvain, "Bread making an overviewIn Bread making",S.P. Chauvin, (eds.), Wodhead Publishing Ltd. Cambridge, England, pp. 8–28,2003.
[11] C. Clarke, T. Schubert, &E. Arendt, "Effect of single strain and traditional mixed strain starter cultures on rheological properties of wheat dough and on bread quality", Cereal Chemistry, V (79), pp. 640–647,2002.
[12] C.Clarke, T Schubert,P. Dockery, "Wheat Sour dough fermentation: effects of time and acidification on fundamental Rheological properties", Cereal Chemistry, III (81), pp. 409–417,2004.

[13] S. Dhingra, S .Jood. "Physico-chemical and nutritional properties of cereal-pulse blends for bread making", Nutritional Health. II (16), pp. 183-94,2002.
[14] G. Dervilly, L. Saulnier, P. Roger."Isolation of homogeneous fractions from wheat water-soluble arabinoxylans. Influence of the structure on their macromolecular characteristics", Journal of Agricultural and Food Chemistry, II (48), pp. 270–278,2000.
[15] D. Cagno, R. Angelis, M. Lavermicocca, P. Vincenzi, M. Giovannini, C. Faccia, M. &Gobbetti. "Proteolysis by sourdough lactic acid Bacteria: effects on wheat flour protein fractions and gliadin peptides involved in human cereal intolerance", Applied and Environmental Microbiology, II (68), pp. 623–633,2002.
[16] C. Don, C. Lichtendonk, J. Plijter, .J. van Vliet, T. Hamer. "The effect of mixing on .glutenin particle properties: aggregation factors that affect gluten function in dough", Journal of Cereal Science, IV (41), pp. 69–83,2005.
[17] E.T. Donohue, &D.M. Peterson. "Isolation and characterization of oat aleurone and starchy endosperm protein bodies", Plant Physiology, III (71), pp. 519–523,1983.
[18] European Commission 2008b. Regulation (EC) 1332/2008 of the European Parliament and of the Council of 16 December 2008 on food enzymes and amending Council Directive 83/417/EEC, Council Regulation (EC) No 1493/1999, Directive 2000/13/EC, Council Directive 2001/112/EC and Regulation (EC) No258/97.Official Journal of the European Union, (5), pp. 7–15.
[19] FDA, U.S. Food and Drug Administration 1997a. Food Labeling: Health claims; Oats and Coronary Heart Disease; Final rule. Federal Register, Vol. 62, No. 15, pp. 3583–3601.
[20] FDA, U.S. Food and Drug Administration. "Food labeling: Health Claims; Soluble Fiber from whole oats and risk of coronary heart disease; Final rule" ,Federal Register, IV (62), pp. 15343–15344 ,1997.
[21] N. Girardet, &F.H. Webster, "Oat milling: specifications, storage",V (60), pp. 1533–1534 2004 .
[22] N. Girardet, "Processing. In: Oats Chemistry and Technology". F.H. Webster &P.J Wood, (Eds.), 2nd ed. AACC International, Inc. St. Paul, MN. Pp. 305–316, 2003.
[23] H. Goesaert, L. Slade, L. Levine, &H. Decor, "Amylases and bread Firming – an integrated view", Journal of Cereal Science, III(50), pp. 345–352,2009.
[24] Health Canada 2010. Food and Nutrition. The Canadian Nutrient File [Homepage of Health Canada, Ottawa, Canada], [Online]. http://webprod3.hc-sc.gc.ca/cnf-fce/index-eng.jsp [2011, 6/9].
[25] K .Iiyama, T. Lam, B.A Stone, "Covalent crosslinks in the cell wall",Plant Physiology, II(104), pp. 315–320,1994.
[26] T. Immerstrand, B. Bergenståhl, T. Trägårdh, C. Nyman, M. Cui & R.Öste, "Extraction of B-glucan from oat bran in laboratory scale", Cereal Chemistry, IV (86), pp. 601–608,2009.
[27] D. Jenkins , K. Kendall, W. Vuksan, V. Vide, E. Parker, T. Faulkner, D. Mehling, .C. Garsetti, M. Testolin, G. Cunnane, S.C. Ryan, "Soluble fiber intake at a dose approved by the US Food and Drug Administration for a claim of health benefits: serum lipid risk factors for cardiovascular disease assessed in a randomized controlled crossover trial". American Journal of Clinical Nutrition, V (75), pp. 834–839,2002.
[28] K. Katina, L. Putamen, "Influence and interactions of processing conditions and starter culture on formation of acids, volatile compounds, and amino acids in wheat sourdoughs", Cereal Chemistry, V (81), pp. 598–610, 2003.
[29] L. Lacey, "Microorganisms in organic dusts". In: R.R Rylander (eds) M. Organic Dusts: Exposure, Effects and Prevention. Boca Raton, FL, USA: CRC Press Inc,:pp.17–41,1994.
[30] E.K Lund, "Fermentable carbohydrate reaching the colon after ingestion of oats in humans",Journal of Nutrition (1991), pp.121:311-312
[31] E.K Lund, J .M Gee, J.C Brown, P.J Wood, and I.T Johnson: "Effect of oat gum on the physical properties of the gastrointestinal contents and on the uptake of D-galactose and cholesterol by rat small intestine in vitro", Br Journal of Nutrition (1989), (62) ,pp.91-101, 1989.
[32] J.A Marlett, Dietary fiber and cardiovascular disease. In "Handbook of dietary fiber" Edited by: Cho SS, Dresher ML. New York: Marcel Dekkerpp.17-25, 2001.
[33] J.A Marlett , Hosig KB, Vollendorf NW, Shinnick FL, Haack VS, Story JA: "Mechanism of serum cholesterol by oat bran", Hepatology, III (20), pp.1450-1457, 1994.
[34] C.F. Morris, "Impact of bleeding hard and soft white wheat on milling and baking quality". Cereal Foods World, II (37), pp.643–644, 1992.
[35] M. Mäki, &P. Collin, Coeliac disease. The Lancet, VIII (349), pp. 1755–175, 91997.
[36] M. Noort, J. van Haste, D. Hemery, Y. Schols, H.A. Hamer, "The effect of particle size of wheat bran fractions on bread quality – Evidence for fiber–protein interactions",Journal of Cereal Science, I (52), pp. 59–64,2010.
[37] B.D. Omaha, "Baking and related properties of wheat-oat composite flours", Cereal Chemistry, III (60), pp. 220–225, 1983.
[38] M. Lakhdara, N. Lazaridou, A. Biliaderis, "Water extractable glucans from barley and oats: an intervarietal study on their structural features and rheological behavior", Journal of Cereal Science, Vol. 42, No. 2, pp. 213–224,2005.
[39] A. Regand, S. Tosh, M. Wolever,"Physicochemical properties of glucan in differently processed oat foods influence glycemic response", Journal of Agricultural and Food Chemistry, X (57), pp. 8831–8838,2009.
[40] F. Saeed, I. Pasha, F. Anjum, &M.Sultan, 2011. "Arabinoxylansandarabinogalactans: a comprehensive treatise", Critical Reviews in Food Science and Nutrition, V(51), pp. 467–476,2011.
[41] E. Theuwissen, & T. Mensink, "Water-soluble dietary fibers and cardiovascular disease". Physiology & Behavior, VIII (94), pp. 285–292,2008.
[42] U.S. Department of Agriculture, Agricultural Research Service 2011, October, 28, last update, USDA National Nutrient Database for Standard Reference, Release 24[Homepage ofUSDA],[Online].Available:http://www.ars.usda.gov/ba/bhnrc/ndl [2012, 2/3].

[43] C.W Wrigley, “proteins with flour power. Nature”, VII (381), pp. 738–739 ,1996.
[44] R. Xu, X. Huang, H & K. “Catecholamine and histidyl protein cross-linked structures in sclerotized insect cuticle”. Insect Biochemistry and Molecular Biology, II(27), pp. 101–108, 1997.