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Quality Attributes of Beef Sausage Supplemented by Flaxseeds and Chickpea

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ABSTRACT

This study was aimed to produce a new low coast product with significant nutritional value using partially replacement of beef meat with milled flaxseeds and chickpea flour.Two sausage formulas were prepared, using 10% flaxseed in formula 1 (F1) and 20% chickpea flour in formula2 (F2) which found to be the most palatable ratios according to the sensory evaluations carried out. The formulas were evaluated for their physicochemical properties, consumer acceptability, approximate chemical composition, minerals content and the profile of amino and fatty acids. The results revealed that, the incorporation of flaxseeds and chickpeas significantly decreased the % of cooking loss and shrinkage while increased the % of cooking yield and water holding capacity. Sensory evaluation showed that there were no significant differences between the control sample and the two prepared formulas in general acceptability. Compared with controls, addition of flaxseeds increased the % of crude fiber, carbohydrates and crude fat as well as Ca, Fe, Zn and P. besides improving the Fatty acids profile and the methionine level. Using of chickpea decreased the fat content while increased both of crude fiber and carbohydrate contents as well as % of Linoleic acid and % of total essential amino acids. As a recommendation of ω6: ω3 polyunsaturated fatty acids should be less than 4,In our investigation we improved ω6: ω3 ratio from 9.32:1in control to 1.07:1 in (F1) by incorporating flaxseeds. Moreover, using flaxseeds and chickpeas in preparing beef sausages reduced the final coasts by 8.3 and 16% respectively.

Keywords: Sausage; Flaxseeds; Chickpea seeds ;Chemical composition

INTRODUCTION

Some people think that relying on plant foods, without using any kind of meat in their meals, can meet their daily dietary needs. Unfortunately, these people may be exposing themselves to micronutrient deficiencies and suffering from small brain volume, tiredness, and lack of understanding. Meat has many crucial nutrients that affect the overall health. Meat provides the body with easily digestible and highly nutritive value protein, containing all the essential amino acids which are vital for normal growth and maintenance of the body. Meat is considered a reservoir for different vitamins and it is rich in vitamin B complex, especially vitamin B 12, compared to plants. (Morris *et al*., 2007).

Processing to form sausages, does not affect the nutritive value harmfully when compared to regular cooking methods. In all meat processing, the aim is twofold: to preserve the meat for longer periods and to alter the flavor and texture to increase variety in the diet, in addition to save the raw material costs especially in developed countries.

Flaxseed (*Linumusitatissimum*), was first grown in Egypt but has been cultivated all around the world. It is nutritious and can be considered functional food according to the Functional Food Science in Europe (FuFoSE) definition, it possesses favorable effects on one or more functions of the human being by either enhancing the general and physical state or/and lessening the risk of of disease development (Doyon and Labrecque,2008).

Scientific researches recommended consumption of flaxseed because it possesses high levels of biologically active nutrients such as n-3, n-6 rich oil, α-linolenic acid, lignans, high quality proteins and fibers that act to prevent some of the chronic diseases such as many types of neoplasia, diabetes, cardiovascular diseases and cerebrovascular stroke (Bernacchia *et al*., 2014). Flaxseeds strongly considered as a natural antioxidant in foods due to its capability of preventing further oxidation reactions; therefore enhancing foods shelf life (Eliasson *et al*., 2003). Incorporation of cheap rich plant protein in meat products allows low income consumers access to animal protein.

Markedly, chickpea is one of the most important pulses in the world due to its nutritional quality. Pulses including chickpea are rich sources of complex carbohydrates, protein, vitamins and minerals (Costa *et al*., 2006 and Wang *et al*., 2010).The importance of legumes is that they are a cheap and dense source of proteins and therefore they are used in poor communities as an alternative to expensive animal protein (Tharanathan and Mahadevamma, 2003).

Chickpea (*CicerArietinum* L.) seeds are the most widely consumed pulse in the world. They are low in fat and high in protein and fiber. Abd EL-Rahim *et al*., (2004) found that chemical composition of raw and cooked chickpea were 8.69, 8.08 % moisture, 3.84, 2.68% ash, 21.85, 24.73 % crude protein, 4.74, 6.05 % crude fiber,6.13, 4.82 % ether extract and 53.88%, 45% total hydrolysable carbohydrates. It is a rich source of quality protein (20–22 %). It has the highest nutritional composition and thus, it is considered a functional food or nutraceutical. Besides proteins, it is rich in fiber and minerals (phosphorus, calcium, magnesium, iron and zinc), and its lipid fraction is high in unsaturated fatty acids (Williams and Singh,1987). This study aimed to produce a new low coast product with significant nutritional value using partially replacement of beef meat with milled flaxseeds and chickpea flour.

MATERIALS AND METHODS

Materials:

15 kg of fresh lean beef meat and 2 Kg of tallow from 24 months old cow were obtained from Assiut slaughter house during November 2017. Visible fat and connective tissues were manually removed (Martinez *et al*., 2009). The lean beef samples were minced using meat mincer and were used for processing of beef sausage as described by Abd El- Aal (2016). Spices mixture was prepared using (clove, black pepper, Chinese cubeb, ginger, Word press button, lura, cinnamon,

seasonings and nutmeg), also salt and fresh garlic were obtained from the local market during November 2017 at Nasr city, Cairo, Egypt. Flax seed (variety Sakha1) was obtained from Agriculture Research Center, Giza, Egypt during November 2017. A variety of chickpea (*CicerArientimum L.*); Giza 195 type was obtained from local market at Assiut city, Egypt during November 2017. Soy flour was obtained from the Food Technology Institute Agriculture Research Center- Giza, Egypt during November 2017. All chemicals used in this study as well as sodium nitrite. Nutrient agar medium, dextrose, sterile peptone was obtained from EL-Gamhouria for Trading Chemicals and Drugs Co., Assiut city, Egypt.

Methods :

Preparation of chickpea flour samples:

The samples were cleaned and subjected to different processing treatments. Chickpeas were processed by following treatments to remove the antinutritional factors as follows:

1- **Soaking**: Chickpea seeds were soaked in sufficient amount of tap water for 8 hrs. The soaked seeds were removed from the water, rinsed three times with distilled water.
2- **Pressure Cooking:** The soaked seeds were pressure cooked in a pressure cooker at 15 psi using water ratio 1:2 for 15 minutes then dehulled followed with drying in an electric oven at 50 C° for 20 hr, then grounded to flour fineness using Laboratory Mill then packaged in polyethylene bags until use (Mittal *et al*.,2012).

Preparation of flaxseeds samples: Flaxseeds were cleaned from impurities and grinded when used directly.

Preparation of beef sausage samples:

Three different formulations (Control, F1, F2) of beef sausage were prepared as shown in Table (1) according to (Egyptian standard for sausage, 1991) with some modifications . The control (C) consisted of minced beef meat only as indicated in Table (1). Other beef sausage formulations (F1, F2) were prepared by partial replacement of beef meat with flaxseed or chickpea as shown in Table (1).

Table 1. Composition of the prepared beef sausage formulas g /(100g)

Ingredients	Control	F1	F2
Minced Beef meat	75	67.5	60
Fat	12	12	12
Milled Flaxseeds	-	7.5	-
Chickpeas(Pressure Cooking)	-	-	15
Law-fat soy flour	10	10	10
Salt	1	1	1
Sodium nitrite	0.01	0.01	0.01
Garlic	0.5	0.5	0.5
Spices	1.49	1.49	1.49

F1= Beef sausage with 10% flaxseeds replacement of beef meat.
F2= Beef sausage with 20% chickpeas replacement of beef meat

The sausage production process was prepared with the formulation given in Table (1). For each batch (5 kg) of the sausage. Meat, fat, and other ingredients were emulsified by using a bowl cutter (Nr-963009, scharfen, Witten, Germany).Chilled water was added (ml / 100 gm formula) to control, F1 and F2,then homogenized for 2 min as follows: 7 ml, 9ml and 20 ml respectively. After emulsification, all batter was stuffed into natural sheep casing mechanically, then grilled for few minutes for color and texture parameters analysis.

Gross chemical composition:

Moisture, crude protein, crude fat, and ash contents were determined according to Official Methods (A.O.A.C. 2000).The carbohydrate content were calculated by difference (Turhan*et al*., 2005) as follows:

% carbohydrate = 100 –(% moisture + % protein + % fat +% ash).

Caloric value was estimated as follows as described by (Mohamed, 2005):

Caloric value (kcal/100 gm) = (% carbohydrate x 4) + (% protein x 4) + (% fat x 9)

Water holding capacity (WHC) was determined using expression of the juice of centrifugation method. The expressible fluid (E.F) was determined by difference between the sample weight before and after centrifugation (Hamm, 1960).

Cooking loss: Prepared beef sausage samples were weighted before cooking and then allowed to cool after cooking to room temperature. After that, the cooked beef sausage samples were reweighted and the cooking loss was calculated according to Lee *et al*. (2008) as follows:

$$\text{Cooking loss (g/100g)} = WR - WC \times 100/WR$$

Where:

WR: the weight of raw sausage (g).
WC: the weight of cooked sausage (g).

Cooking yield was calculated as given by (El- Nemr, 1979).

$$\% \text{ Cooking yield} = 100 - \% \text{ Cooking loss}$$

Shrinkage:

Change in beef sausage diameter and length (Shrinkage) was measured on cooked samples as mentioned by George and Berry (2000) using the following equations:

$$\% \text{ Shrinkage} = \frac{\text{Uncooked diameter or length(cm)} - \text{Cooked diameter or length(cm)} \times 100}{\text{Uncooked diameter or length (cm)}}$$

Sensory evaluations:

Grilled sausage samples were evaluated by 10 staff members in the Food Science and Technology Department, Faculty of agriculture, Assuit University and Assiut Agricultural Research Center who are familiar with meat products. A 10- point hedonic scale (1 being dislike very much to 10 being like very much) for color, taste, flavor, texture and overall acceptability were used to evaluate the sensory attributes of sausage sample according to (Gelman and Benjamin, 1989).

Amino acids composition:

Amino acids were determined according to the method described by Pellett and Young(1980). The analysis was performed in Regional Center for Food and Feed, Agriculture Research Center- Giza, Egypt using Beckman Amino Acid Analyzer Model119CL.

Determination of tryptophan:

Tryptophan was determined using spectrophotometric method as described by Sastry and Tummuru (1985).

Determination of fatty acids composition as mentioned by (Rossell *et al*., 1983).

Determination of minerals content was carried out in Central Laboratory, Faculty of Agriculture, Assiut University, as described in AOAC (1995).

Crude fiber content was expressed as percentage loss in weight on ignition (AOAC. 1990).

Final coast:

The final costs of the prepared beef sausage samples were calculated according the local market costs of the used ingredients by Egyptian pound.

Statistical analysis: The data obtained from three replicates were analyzed by ANOVA using the SPSS statistical package program, and differences among the means were compared using the Duncan's Multiple Range test (SPSS, 2011). A significance level of 0.05 was chosen.

RESULTS AND DISCUSSION

Data for proximate analysis (on dry weight) of raw meat, chickpeas, flax seeds and soybeans used in formulating are presented in Table (2).

As shown in Table (2) chickpeas, flaxseeds and soybean flour had an acceptable percentage of carbohydrates, besides high ash content in both low fat soybean flour (6.69%) and flaxseeds (4.47%). Flaxseeds had the highest fat content (41.21%) which considered one of the richest dietary sources of the omega-3 fatty acid α-linolenic acid (ALA) "an essential fatty acid, which means that the body cannot produce it.

Flaxseeds contained 24.8 % protein , this result was nearly from the result of Chung *et al*, (2005) who mentioned that flaxseed grain contain about 21% protein

(Sanjeewa 2008) reported that, chickpeas are excellent sources of protein, dietary fiber, complex carbohydrates, and trace minerals such as iron, molybdenum, and manganese.

Table 2. Gross chemical composition of the ingredients included in the studied formulas (on dry weight basis)

Parameters (%)	Ingredients			
	Raw beef	Chickpea flour	Flaxseeds	low fat Soy flour
Moisture	73.62[a]	10.22[b]	7.52[c]	4.28[d]
Protein	77.56[a]	22.3[d]	24.88[c]	48.98[b]
Fat	10.54[b]	5.35[d]	41.21[a]	7.27[c]
Ash	3.87[c]	2.19[d]	4.47[b]	6.69[a]
Carbohydrates	8.04[d]	70.16[a]	29.44[c]	37.04[b]

***Carbohydrates were calculated by difference**

Results in Table (3) revealed that, the control sample contained the higher contents of both moisture and protein (on dry weight basis). The protein content in control sample increased because the high meat water content decreases though, nutrients become more concentrated after drying. The partial replacement of beef meat with flax seeds and chickpeas markedly increased the content of dietary fibers significantlyfrom4.9 in control sample to 10.22% and 7.93% in F1 and F2 respectively. As known, increasing intake of dietary fibers can reduce constipation and help with weight loss and maintenance. It may also lower cholesterol levels, as well as the risk of diabetes and heart disease. F1 signed the highest fat content (31.28%) due to the high appreciable fat % in flaxseeds (41.21%) while the lowest fat content was found in F2 (25.3 %) as expected due to adding 15% chickpea flour, this result is in agreement with those of Mansour (2003) and Owon *et al*, (2014). It was expected that the % of protein in F1 would be the greater due to the highest protein content in flax seeds (23.1%) which overcome the protein content in row beef meat (20.46%), but due to the highly moisture content in fresh meat (73.62%) compared with 7.52% in flax seeds, we obtained the logic results that the highest protein content were found in control sample when calculated on dry weight. Although chickpea seeds had the higher content of carbohydrates, the lowest caloric value was obtained in F2 (499.56K.cal/100g), this is due to the lowest fat and protein content in chickpeas flour. These results are confirmed with those of Owon *et al*., (2014).

Table 3. Effect of partial replacement of beef meats by flaxseeds or chickpeas on chemical composition and caloric value of the studied formulas (on dry weight basis).

Sample Parameter(%)	Control	F1	F2
Moisture	58.84[a]	52.80[c]	53.56[b]
Protein	51.87[a]	46.65[b]	41.17[c]
Fat	30.44[b]	31.28[a]	25.30[c]
Ash	7.17[b]	7.20[a]	6.74[c]
Crude fiber	4.90[c]	10.22[a]	7.93[b]
N. F. E.	5.62[b]	4.65[c]	18.86[a]
Total Carbohydrates	10.52[c]	14.87[b]	26.79[a]
Energy (K.Cal/100g)	523.52[b]	527.6[a]	499.54[c]

F1= Beef sausage with 10% flaxseeds replacement of beef meat.
F2= Beef sausage with 20% chickpeas replacement of beef meat
N.F.E= Nitrogen free extract (%Total Carbohydrates-%crude fiber).
Different liters in the same row means significantly differences ($p<0.05$)

Physical properties:

As shown in Table (4), adding both chickpeas and flaxseeds improved significantly cooking yield, WHC, cooking loss and shrinkage, this is due to the high fiber content in both chickpeas and flaxseeds. As a consequent of increasing cooking yield and WHC, the shrinkage % and cooking loss were decreased by adding chickpeas flour or milled flaxseeds. Chickpeas flour was characterized with good water holding and emulsifying capacities (Kohajdovaet *et al*, 2011). However Yogesh *et al*,(2015) found that cooking loss decreased significantly in treated meat batter with flaxseed powder when compared with control sample, due to flax seed ability of keeping the moisture in the matrix. For the water holding capacity, the expressible water values explained how the addition of flax seeds and chickpeas meal improved the water holding capacity in F1 and F2 compared with control sample.

Table 4. Physical properties of the prepared beef sausage at zero time

Sample	Cooking yield %	Cooking loss %	Shrinkage %	Moisture %	E. F.* %	W.H.C (%Bound water)
Control	89.99[c]	10.01[a]	6.8[a]	58.84[a]	2.02	56.82[a]
F1	91.34[b]	8.66[b]	5.72[b]	52.80[c]	1.52	51.28[c]
F2	91.82[a]	8.18[c]	5.36[c]	53.56[b]	1.05	52.15[b]

F1= Beef sausage with 10% flaxseeds replacement of beef meat.
F2= Beef sausage with 20% chickpeas replacement of beef meat
E.F.*= Expressible fluid (%moisture – W.H.C)
W H C= Water holding capacity.
Different liters in the same column means significantly differences ($p<0.05$)

Sensory evaluation:

According to the means given by the panelists of grilled samples at zero time ,sensory scores for studied parameters such as taste, texture, odor, color and general acceptability were varied and affected significantly by the addition of chickpea flour or milled flax seeds Table (5).

Results revealed that there were no significant differences in general acceptability between the control sample and the two prepared formulas. The control sample had the highest taste, odor and color values while had similar texture value with F1 which is in line with what Bilek and Turhan(2009) reported, that the addition of flaxseed flour significantly affected the appearance, flavor, tenderness, juiciness and overall acceptability of beef patties.

Table 5. Sensory evaluation of the prepared beef sausages

Sample	Taste	Texture	Odor	Color	overall acceptability
Control	9.95^{a}	9.63^{a}	9.88^{a}	9.92^{a}	9.90^{a}
F1	9.50^{c}	9.30^{ab}	9.33^{c}	9.20^{c}	9.54^{b}
F2	9.83^{b}	9.00^{c}	9.64^{ab}	9.75^{b}	9.85^{ab}

F1= Beef sausage with 10% flaxseeds replacement of beef meat.
F2= Beef sausage with 20% chickpeas replacement of beef meat
Different liters in the same column means significantly differences ($p<0.05$)

Mineral content:

Mineral analysis in Table (6) indicated that F1 contained the greater amounts of some elements such as Ca, Fe, Zn and P exceeded their concentrations in control and F2 samples. As mentioned above in Table (2), flaxseeds had the highest ash content (4.47%) compared with beef meat and chickpeas. Due to the highly mineral content in flaxseeds it was expected that F1 would have the highest content in several minerals, this agreed with results of Singh *et al*., (2011), who reported that flaxseeds are a source of many vitamins and minerals as calcium, magnesium and phosphorus.

F2 had the lowest minerals content except P because they leached from the chickpea seeds into the water during cooking treatments as recorded by Alajaji and El-Adawy (2006).

Table 6. Minerals composition of the prepared beef sausages (mg/100g dry weight basis)

Minerals Sample	Ca	Fe	Zn	Na	K	P
Control	169.74	39.90	9.95	1630.11	776.95	175.13
F1	246.85	45.77	15.23	1341.71	491.26	248.60
F2	146.61	36.93	8.61	922.81	456.79	214.89

F1= Beef sausage with 10% flaxseeds replacement of beef meat.
F2= Beef sausage with 20% chickpeas replacement of beef meat.

Fatty acid composition:

The profile of saturated and unsaturated fatty acids (percentage contribution of each fatty acid to total fatty acids) of the three studied beef sausage formulas is shown in Table (7).

Data in Table (7) shows that, the total saturated fatty acids were higher in control sample (50.02%) than F1 (43.95%) and F2 (47.66%), this is because meat is seen to be a major source of fat in the diet and especially of saturated fatty acids (Wood *et al*, 2003).It was recorded that saturated fatty acids have a bad reputation linked with diseases associated with modern life, especially in developed countries. These include various cancers and especially coronary heart disease. And so, adding flaxseeds in F1 and chickpea in F2 lowered saturated fatty acids content. On the other hand both F1 and F2 had higher amounts of total unsaturated fatty acids than control sample Table (7). Neither omega -3 nor omega-6 fatty acids can be synthesized by humans, only plants (including marine phytoplankton) can do, there for it is recommended that humans consume more omega-3 fatty acids from vegetables and marine sources (Mahan, 2016). The detected % unsaturated fatty acids (USF) in control sample specially Linoliec and Linolenic acids due to the 10% soy beans addition besides that ruminant meats, especially from animals that have consumed grass contains high levels of 18:3.

Table 7. Fatty acids composition of the prepared beef sausage (as% of total fatty acids)

Fatty acids	Carbon Chain	Control	F1	F2
Myristicacid	C14:0	2.63	2.52	2.73
Pentadecanoicacid	C15:0	0.36	0.34	0.38
Palmiticacid	C16:0	21.21	20.29	21.84
Margarinicacid	C17:0	1.31	1.04	1.19
Stearicacid	C18:0	23.40	19.22	21.32
Arachidicacid	C20:0	0.22	0.18	0.20
Docosanoicacid	C22:0	0.05	-	-
Total saturated fatty acids		50.02	43.59	47.66
Myristioleicacid	C14:1	0.40	0.14	0.16
14,Pentadecenooic acid	C15:1	-	0.17	0.18
Palmitolcicacid	C16:1	1.73	1.68	1.67
Heptadecenoicacid	C17:1	0.63	0.48	0.52
Oleicacid	C18:1	38.43	34.68	36.55
Linoleicacid	C18:2	5.78	7.10	9.37
	C18:2T	0.696	0.38	0.60
Llnolenicaid	C18:3n3	0.62	9.62	1.03
Eicoaaenoicacid	C20:1	0.27	0.39	0.34
Total Unsaturated fatty acids	-	48.56	54.64	50.42
n-6 : n-3	-	9.32:1	1.07:1	9.09:1
P:S*	-	0.97	1.3	1.06

***Poly unsaturated fatty acids: Saturated fatty acids**

Farno (1996) mentioned that, soybean oil is composed of approximately 16% saturated fatty acids (palmitic [C16:0] and stearic [C18:0]), 24% monounsaturated fatty acids (oleic [C18:1]), and 60% polyunsaturated fatty acids (linoleic [C18:2] and linolenic [C18:3]). The most obvious difference in fatty acid composition between studied formulas was that linoleic acid (18:2) was higher in F2 (9.37%) than that of F1 (7.10%) while control sample had the least concentration (5.78%). F1 was superior in linolenic acid content which marked (9.62 %) compared with F2 (1.03%) and (0.62%) in control sample. This is can be explained as mentioned by Simopoulos (2002) who obtained that α-linolenic acid (ALA), recorded about 30% , linoleic acid recorded 17% and oleic acid recorded19% of all lipids in flaxseed, which provides an excellent ω6: ω3 fatty acid ratio (0.3:1). Therefore, the seed could be acompensatory source of this fatty acid to populations when the marine foods are not available, which are the best sources of n-3 fatty acids (Bernacchia *et al*., 2014). Partial replacement using flaxseeds or chickpea improved the ratio (P: S) of polyunsaturated fatty acids (PUFA) to saturated fatty acids (SFA) which recorded in control, F1 and F2 (0.9,

1.3 and 1.06) respectively leading to the balanced fatty acid intake of today's consumers. despite that the diet containment of both omega-6 and omega-3 fatty acids is important, , surplus levels of omega-6 fatty acids may interfere with the enzymes responsible of desaturation and elongation of both ω 3 and ω 6 fatty acids and prevention of the conversion of ALA into longer EPA and DHA forms (Kris-Etherton *et al*.,2000). Moreover, Haag (2003) reported that the ratio of omega-6 to omega-3 in the diet affect neurotransmission and subsequently brain function.

Enser (2001) reported that the ratio of ω6: ω3 PUFA is a potent factor that can worsen cancers and coronary heart disease, especially in cases of clot formation that lead to heart attacks. It is recommended that the ratio of ω6: ω3 PUFA should not exceed 4, taking into account that the ratio may exceed that in some kinds of meat.

Simopoulos (2002) Eating meals containing excessive amounts of polyunsaturated fatty acids (PUFA) and ا high ratios of ω6 / ω3, as is common in the current Western (15/1 - 16.7 / 1), make humans more inclined to some diseases such as cardiovascular disease, cancer, inflammatory and autoimmune diseases, while increased levels of omega-3 PUFA (low ω6 / ω3 levels) reduce the risk of these diseases..

In the secondary prevention of cardiovascular disease, a ratio of 4/1 was associated with a 70% decrease in total mortality. A ratio of 2.5/1 reduced rectal cell proliferation in patients with colorectal cancer. In our investigation we succeeded to low the ω6: ω3 ratio from 9.32:1in C to 0.74:1in F1 by incorporating flax seeds which considered a very good source of ALA.

Amino acid composition:

Meat proteins have all essential amino acids (without any shortage or limitation)(Schaafsma, 2000).Compared with the FAO/WHO (1973) reference, chickpea protein is rich in essential amino acids such as isoleucine, lysine, total aromatic amino acids and tryptophan.

Alajaji and El-Adawy(2006) mentioned that, chickpea protein plays a complementary role to the low protein sources in lysine and tryptophan. They pointed that, chickpea protein has slightly deficiency in leucine; total sulfur amino acids, threonine and valine when compared with the reference pattern. Boiling and microwave cooking improve the total essential amino acids profile; otherwise, long cooking time reduces the nutritive value of legumes as the levels of some essential amino acids are markedly decreased (Chau *et al*., 1997).

By excluding both of methionine and phenylalanine Chickpea has sufficient amount of all essential amino acids and is nutritionally better when treated with roasting and pressure-cooking.

Results in Table (8) postulated that the amino acid composition were similar in the three formulas in both essential and non-essential amino acids. F2 was superior in Lysine content and total essential amino acids, meanwhile F1 had the highest methionine content.

Total cost calculations:

According to obtained data in Table (9), using flaxseeds and chickpeas in preparing beef sausages reduced the final coasts by 8.3 and 16% respectively.

Table 8. Amino acids composition of the prepared beef sausage (g/100g protein)

Amino acids	Control	F1	F2
Aspartic	7.19	7.22	7.21
Serine	2.85	2.59	5.10
Glutamic	12.96	13.25	9.81
Glycine	3.72	4.01	3.33
Alanine	4.32	4.24	3.81
Histidine	2.56	2.42	2.45
Arginine	4.97	5.51	5.54
Proline	3.53	3.47	2.96
Cystine	1.66	1.93	2.94
Tyrosine	2.58	2.49	2.55
Total non essential amino acids	46.34	47.31	45.70
Lysine	5.86	5.23	6.63
Leucine	5.98	5.55	5.85
Isoleucine	3.39	3.28	3.72
Methionine	1.79	2.23	1.92
Phenylalanine	3.23	3.26	3.62
Therionine	3.20	2.92	3.28
Valine	3.82	3.77	3.98
Tryptophane	0.93	0.94	0.91
Total essential amino acids	28.2	27.18	29.91

F1= Beef sausage with 10% flaxseeds replacement of beef meat.
F2= Beef sausage with 20% chickpeas replacement of beef meat.

Table 9. Total cost of the prepared beef sausage (Egyptian pound / 1Kg)

Formulas Ingredients	Control		F1		F2	
	gm	Cost (EP)	gm	Cost (EP)	gm	Cost (EP)
Beef meat	750	97.5	675	87.75	600	78
Fat	120	2.4	120	2.4	120	2.4
Flaxseeds	-	-	75	1.125	-	-
Chickpea seeds	-	-	-	-	150	3
Soy Flour	100	1.9	100	1.9	100	1.9
Salt	10	0.04	10	0.04	10	0.04
Garlic	5	0.013	5	0.013	5	0.013
Spices	14.9	1.49	14.9	.49	14.9	1.49
Sodium nitrite	0.1	0.072	0.072	0.072	0.1	0.072
Final cost	-	103.415	-	94.79	-	86.915
% of reduction				8.3		16

F1= Beef sausage with 10% flaxseeds replacement of beef meat.
F2= Beef sausage with 20% chickpeas replacement of beef meat.
EP=Egyptian pound

CONCLUSION

Partial replacement of meat using flaxseeds and chickpeas improved the physical properties, increased the % of crude fiber, carbohydrates and crude fat as well as Ca, Fe, Zn and P. Moreover, improved the fatty acids profile, also reduced the ω6: ω3 ratio by adding flaxseeds. Furthermore, using flaxseeds and chickpeas in preparing beef sausages reduced the final coasts by 8.3 and 16% respectively.

REFERENCES

A.O.A.C. (1990). Official methods of analysis, 14th edition, Association of Official Analytical Chemists, Washington DC. Arlington, Virginia, USA.

A.O.A.C. (1995): Official Methods of Analysis of the Association of Official Analytical Chemistry. 16th ed., AOAC International, Washington, USA., Pages: 1141.

A.O.A.C. (2000) Association of Official Analytical Chemists, 17th Ed. Of A.O.A.C. International. Published by A.O.A.C. international. Maryland, U.S.A., 1250pp.

Abd El-Rahim, E. A.; Abd El-Salam, S. M.; Moursy, F. I. and Alam, S. O. (2004). Effect of processed chickpea on blood glucose and cholesterol levels of experimental animals. J. Agric. Res., 82 (2): 781-792.

Alajaji, S.A. and El-Adawy, T.A .(2006) Nutritional composition of chickpea *(Cicerarietinum* L.) as affected by microwave cooking and other traditional cooking methods. Journal of Food Composition and Analysis.

Bernacchia, R.; Preti, R . and Vinci, G. (2014) Chemical Composition and Health Benefits of Flaxseed Austin Journal of nutrition and food science; 2(8): 1045.

Bilek, A..E. and Turhan, S. (2009). Enhancement of the nutritional status of beef patties by adding flaxseed flour. Meat Sci., 82: 472-477.

Chau, C.F.; Cheung, P.C.K. and Wong, Y.S.(1997) Effects of cooking on content of amino acids and antinutrients in three Chinese indigenous legume seeds. J. Sci Food Agric. 75: 447 – 452.

Chung, M.W.Y.; Lei, B . and Li-Chan, E.C.Y. (2005) Isolation and structural characterization of the major protein fraction from NorMar flaxseed (*Linumusitatissimum* L.).Food Chem. 90: 271-279.

Costa,G.E.K.; Queiroz-Monici,S. and Reis, A.C. (2006). Oliveira, Chemical composition, dietary fiber and resistant starch contents of raw and cooked pea, common bean, chickpea and lentil legumes, Food Chemistry, 94, 327-330.

Doyon M. and Labrecque J . (2008) Functional foods: a conceptual definition. British Food Journal. 110: 1133- 1149.

Egyptian Standard for sausage, (1991) Frozen sausage , Egyptian Standard No. 1973 Egyptian Organization for Standardization and Quality Control , Ministry of industry Arab Republic of Egypt.

Eliasson, C.; Kamal-Eldin, A.; Andersson, R. and Aman, P.(2003) High performance liquid chromatographic analysis of secoisolariciresinoldiglucoside and hydroxycinnamic acid glucosides in flaxseed by alkaline extraction. Journal of Chromatography A, 1012(12): 151-159.

El- Nemr, S. E. A. (1979) Studies on Meat Substitutes, M. Sc. Thesis, Faculty of Agric., Zagazig Univ., Zagazig, Egypt.

Enser, M. (2001) The role of fats in human nutrition. In B. Rossell (Ed.), Oils and fats, Vol. 2. Animal carcass fats (pp. 77–122). Leatherhead, Surrey, UK: Leatherhead Publishing.

FAO/WHO, (1973) Energy and Protein Requirements. Report of FAO Nutritional Meeting Series, No. 52, Rome.

Farno L. A. (1996) Oil and fatty acid profiles of soybeans https://pdfs.semanticscholar.org/6667/0eccf53d0b2410dbd6a4ff0553b0cef5ac7c.pdf

Gelman, A. and Benjamin, E. (1989) Characteristics of mince from Pond-bred silver carp (Hypopthamichthysmolitrix) and preliminary experiments on its use in sausage. J.Sci.Food Agriculture, 47, 225- 241.

George, M.E.B. and Berry, B.W. (2000) Thawing prior to cooking affects sensory, shear force and cooking properties of beef pattie. J. Food Sci. 65 (1), 2–8.

Haag, M. (2003) Essential fatty acids and the brain,CanPsycbiatry. 48-195

Hamm, R. (1960). Biochemistry of meat hydration. Adv. Food Res.10, 355.

Kohajdova Z.; Karovikov, J. aandMagala ,M. (2011). Utilisation Of chickpea flour for crackers production . Ata ChimicaSlovaca , Vol.4, No.2, ,98-107

Kris-Etherton,P.M.;[1] Taylor,D.S.; Yu-Poth,S.; Huth,P.; Moriarty,K.; Fishell,V.; Hargrove, R.L.; Zhao, G. and Etherton, T.D. (2000) Polyunsaturated fatty acids in the food chain in the united states , Am Clin. Nutr. 71:197.

Lee, M.A.; Han, D.J.; Jeong, J.Y.; Choi, J.H.; Choi, Y.S. and Kim, H.Y. (2008) Effect of kimchi powder level and drying methods on quality characteristics of breakfast sausage. Meat Sci. 80, 708–714.

MahanL. K.(2016) Krause's Food & Nutrition (14thEdition) Evolve ELSEVIER.COM.

Mansour, E. H. (2003) Effect of carbohydrate- based fat replacers on the quality characteristics of low-fat beef burgers. Bull. Faculty Agri., Cairo Univ., 54: 409-430.

Martinez, B., Miranda, J. M.; Vazquez, B. I.; Fente, C. A.; Franco, C. M..; Jose L; Rodriguez, J. L.andCepeda, A. (2009). Development of Hamburger Patty with Healthier Lipid Formulation and Study of its Nutritional, Sensory, and Stability Properties. Food Bioprocess Technol, DOI 10.1007/s11947-009-026

Mittal, R.; Nagi, H.P.S.; Sharma, P. and Sharma ,S. (2012) Effect of Processing on Chemical Composition and antinutritional Factors in Chickpea Flour, Journal of Food Science and Engineering (2) 180-186 Mohamed, H. A. A. (2005) Low Fat Meat Products as Prepared from Ostorich and other Reduced Fat Beef. Ph. D. Thesis, Nutrition and Food Science Dept., Faculty of Home Economics, Menufiya, Univ., Egypt.

Morris, M.S., Jacques, P.F., Rosenberg, I.H. and Selhub, J.(2007) Folate and vitamin B-12 status in relation to anemia, macrocytosis, and cognitive impairment in older Americans in the age of folic acid fortification. Am. J. Clin. Nutr. 85 (1), 193–200.

Owon, M. A.; El – Demery, M .E.; Lotfy, L. M. and Elmoghany, A. S. (2014) Quality attributes of low – fat beef burgers formulated with chickpea flour. J. Food and Dairy Sci., Mansoura Univ., Vol. 5 (6): 389 - 402,

Pellett, P. L., and Young, V. R., (1980):Nutritional evaluation of protein foods. Foodand Nutrition Bulletin, (Suppl. 4).

Rossell, J. B.; King, B. and Downes, M. J. (1983). Detection of adulteration. J. Am. Oil. Chem. Soc., 60, 333.

Sanjeewa, W.G.T.(2008) Physico-Chemical Properties of Chickpea Flour, Starch and Protein Fractions and their Utilization in Low-Fat Pork Bologna. M.Sc. Thesis Department of Food and Bioproduct Sciences, University of Saskatchewan, Saskatoon, Saskatchewan,Canada.https://harvest.usask.ca/bitstream/handle/10388/etd08252008115650/thushan.pdf?sequence=1&isAllowed=y

Sastry, C . S . P. and Tummuru, M. K. (1985) Spectrophotometric determination of tryptophan in proteins.Jfood,SCI.Technol,22,pp146:147.

Schaafsma, G. (2000) The Protein Digestibility-Corrected Amino Acid Score. J Nutr 130: 1865S-1867S.

Simopoulos, A.P.(2002) The importance of the ratio of omega-6/omega-3 essential fatty acids. See comment in PubMed Commons below Biomed Pharmacother.; 56: 365-379.

Singh, K.K.; Mridula D.; Rehal, J .and Barnwal P. (2011) Flaxseed: a potential source of food, feed and fiber. Food SciNutr.; 51: 210-222.

SPSS, (2011) SPSS for windows. Release, 20.0., Standard Version, Armonk, NY:IBM Corp.

Tharanathan, R.N.andMahadevamma, S. (2003) subject trends Food Sci. Technol., 14:507-5018.

Turhan, S.; Sagir, I. and Ustun, N. S. (2005). Utilization of hazelnut pellicle in low-fat beef burgers. Meat Sci., 71, 312-316.

Wang, N.; Hatcher, D.W.; Tyler, R.T .and Toews, E.J. (2010). Gawalko, Effect of cooking on the composition of beans (PhaseolusvulgarisL.) and chickpeas (Cicerarietinum L.), Food Research International, 43, 589-594.

Williams, P. C. and Singh, U. (1987). Nutritional quality and the evaluation of quality in breeding program. In Chickpea CAB International, Wallingford Oxon UK, 329–356.

Wood, J.D.; Richardson, R.I.; Nute, G.R.; Fisher A.V.; Campo, M. M.; Kasapidou, E.; Sheard, P.R. and Enser, M. (2003) Effects of fatty acids on meat quality: a review, Meat Science 66 21–32 .

Yogesh, K.; Langoo, B.A.; Sharma, S. K. and Yadav, D.N. (2015) Technological , Physico-chemical and sensory properties of raw and cooked meat batter incorporated with various levels of cold milled flax seed powder. J Food Sci. Technol ((March 2015)52 (3):1610-1617.

خصائص الجودة للسجق البقرى المدعم ببذور الكتان والحمص

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هدفت هذه الدراسةالى اعداد منتجا جديدا للسجق البقرى مرتفع القيمة الغذائية ومنخفض التكلفة عن طريق الاستبدال الجزئى للحم البقرى بنسبة 10% مطحون بذور الكتان في الخلطة الاولى (F1) او 20% مطحون بذور الحمص في الخلطة الثانية (F2) والتى حازاتا افضل تقبل حسى من خلال التقييم الحسى الذى تم للعينات . تم اختبار الخلطتان من ناحية الخصائص الفيزيوكيميائية , قبول المستهلكين , التركيب الكيميائى , المحتوى من الأملاح المعدنية والأحماض الأمينية والدهنية. أوضحت النتائج أن تضمين بذور الكتان اوالحمص أخفضت معنويا النسبة المئوية لفقد الطهى والإنكماش بينما زادت من عائد الطهى والقدرة على الإحتفاظ بالماء. أظهر التقييم الحسى عدم وجود اختلافات نوعية بين العينة الكنترول وبين الخلطتين المحضرتين فى القبول العام. بالمقارنة بالكنترول. أضافة بذور الكتان زادت من النسبة المئوية للألياف الخام, الكربوهيدرات , الدهون الخام وأيضا قيم الكالسيوم , الحديد , الزنك والفسفور. بجانب تحسين تركيب الأحماض الدهنية ومستوى المثيونين. استخدام الحمص أخفض المحتوى الدهنى بينما رفع المحتوى لكل من الالياف الخام والكربوهيدرات كما رفع النسبة المئوية لحمض اللينولييك والنسبة المئوية لمجموع الأحماض الأمينية الأساسية. طبقا للتوصيات الصحية فان النسبة بين الأحماض الدهنية عديدة عدم التشبع أوميجا 6 : أوميجا 3 يجب أن تكون أقل من4فقد ادىاستخدام مطحون بذورالكتان في هذه التجربة الى خفض هذه النسبة من9.32: 1 فى الكنترول إلى 1.07 :1 فى الخلطة الاولى (F1). من ناحية اخرىادى استخدام كل من بذور الكتان والحمص فى تحضير السجق البقرى الى خفض التكلفة النهائية بمقدار 8.3% و 16% على التوالى.