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Original Research Article

EFFECT OF USING CHICORY ROOTS POWDER AS A FAT REPLACER ON BEEF BURGER QUALITY

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Abstract: Chicory roots powder is considered as a rich source of fiber and polyphones. It can be interfered in the formation of many functional foods that play an important role in maintaining human health from many diseases such as obesity and diabetes. So, this research was carried out to determine the chemical composition of the chicory roots and to evaluate assess the quality properties of reduced- fat burger as influenced with chicory roots powder. The prepared burger samples contained chicory roots powder as fat replacer with substitution ratio of 25, 50 and 75% of animal fat. Cooking quality and sensory evaluation were measured in burger samples. The results revealed that adding Chicory roots powder lead to an improvement in burger nutritional value and cooking properties. In burger contained chicory roots powder, there was an increment in cooking yield meanwhile, shrinkage and feeder number were decreased. Adding chicory roots powder to burger as a fat replacer does not cause any negative effects on its sensory properties.

Key words: fat replacer; burger; dietary fiber

Introduction

Consumers now have good knowledge about their health and food. Therefore, healthy processed meat product must have low fat, cholesterol, and calories (1). Burger is considered as one of the highest popularity food in Egypt and all over the world (2). It has a high acceptability and consuming rates because it is a cheap quick meal (3). On the other hand, it has some harmful effect due to high content of saturated acids (20-30%) (4). Fat has an important role in burger increasing emulsion stability of meats as well as water holding capacity; decreasing loss during cooking process and improving organoleptic characteristics (5). However, the presence of fats in meat products leads to a high content of cholesterol and saturated fatty acids (6). The increment of saturated fats intake levels causes harmful diseases such as, cardiovascular disease, stroke, obesity and cancer (7). Obesity is one of the most serious diseases in the world, especially as it is linked to other diseases such as heart disease and diabetes (8).

According to the American Heart Association (2002), fat should be shared with about 15% to 30% of the total calories taken daily. WHO also recommended that saturated fat should not exceed 10% of daily supplemented calories (9, 11).

Therefore, many studies have been conducted to produce healthy meat products and reducing the proportion of fat. On the other hand, it must be borne in mind that this may lead to some problems with the acceptance of the prod-

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uct, because fat is a main component that effects on meat product properties such as sensory attributes, texture and flavor (12, 13). Reducing the proportion of fat by adding substances that are based on non-meat proteins, carbohydrate and dietary fiber is a scientific way to solve this problem (14).

Dietary fiber is a part of plant food that is not fully digested by digestive enzymes, and it is very important for human health. On the other hand, human consume dietary fiber less than recommended by the WHO (23–38 g/day) (15, 16). In processed foods, part of the fat is replaced by dietary fiber (17). In meat processing, crude fiber has good applications in minimizing formula cost cooking yield enhancement, and texture improvement (18). Several studies have shown the importance of fiber to human health, it helps to reduce cholesterol, also reduce high blood pressure and reduce the chances of colon cancer as well as obesity (19, 20).

Cichorium intybus L. (chicory) is a Mediterranean plant species belonging to the Asteraceae family. Cichorieae tribe includes approximately hundred genera and many hundreds species of which some genera are used as salad vegetables (21). On the other hand, the word 'Chicory'is likely to be derived from the Egyptian word 'Ctchorium'. All parts of this plant are pharmacologically useful due to the presence of a number of medicinally and nutritionally important compounds such as inulin, flavonoids, caffeic acid derivatives, terpenoids, sesquiterpene, vitamins, steroids oils, lactones, volatile compounds, and coumarins, It possesses antibacterial, antioxidant and anti-inflammatory (22).

There is not enough information about using chicory as a fat replacer in meat products; therefore, the main aim of this study was to evaluate addition of chicory powder at different levels as fat replacer on burger quality attributes.

Materials and methods

Chicory (*Cichorium intybus*) was obtained in January, 2017 from the local field of Kafr El-shiekh governorate, Egypt. The chicory roots were free of physical damage and injury of insects and fungi infection. Beef meat and other components used for burger preparation were obtained from local market at Kafr El-shiekh city, Egypt.

Chemicals

All chemicals and reagents used in this study were obtained from Sigma Aldrich Chemical Co. (St. Louis, M.O, USA). All other chemicals and solvents were of analytical grade.

Preparation of Chicory roots powder

The plant of chicory were transferred directly to the laboratory of food technology department, Faculty of Agriculture, Kafrelshiekh University then it was washed with tap water to removeremaining soil and other impurities. The chicory roots were cut into small pieces and dried at 40ºC for 2 days in an air oven. The dried roots were crushed using a laboratory mill, then, sieved (100 meshes) and finally, the powder was stored in sealed bags at 4± 2ºC (23).

Burger preparation

The beef burger was formulated to contain the following ingredients 80% red beef meat, 20% kidney fat, 18% (w/w) water (ice), 1.5% (w/w) salt, ground black pepper (0.3%), red pepper (0.2%) and cumin (0.2%) according to Aleson-Carbonell, Fernández-López (24). Aforementioned ingredients were used to prepare the control sample while 25, 50 and 75% of control fat content were replaced by chicory roots powder to prepare burger supplemented with chicory roots powder as a fat replacer.

Meat burgers weighed approximately 30 g each. The beef burgers were stewed using an electrical grill (Genwex GW-066) at 220°C (the space between heat source and the samples was 4 cm) for 8 min (4 min for each side of beef burgers).

Chemical analyses

Gross chemical composition of chicory roots and burger was analyzed according to A.O.A.C. (25).

$$\text{Cooking yield (\%)} = \frac{\text{Cooking weight}}{\text{Raw weight}} \times 100$$

$$\text{Shrinkage (\%)} = \frac{\text{Raw diameter - Cooking diameter}}{\text{Raw diameter}} \times 100$$

Cooking loss (%) = ((Raw weight - Cooking weight)/ Raw weight)*100

$$\text{Feeder number} = \frac{\text{Moisture content \%}}{\text{organic nonfat content \%}}$$

Where, % organic non fat = 100 – (fat % + ash content + moisture %)

Sensory evaluation

Sensory evaluation of twenty panelist have been assessment burger samples for their sensory properties (taste, color, odour, texture, tenderness and overall acceptability) using a hedonic scale of 1-10 according to the method of Badr and El-Waseif (28)

Statistical analysis

General linear model of SPSS (Ver. 16.0, 2007) was used to conduct ANOVA for determination of differences between means. The probability levels of $P \leq 0.01$and $P \leq 0.05$ were considered to be significant for statistical procedures. All measurements and trials were done in triplicate.

Results and discussion

Chemical composition of chicory roots powder

Moisture and protein content of chicory roots powder were 6.84±0.89 and 9.01±0.93 (Table1) .On the other hand, data in Table (1) showed that, chicory roots had a high ash content (5.60%) and ether extract (1.60%), crude fiber (5.92%) and antioxidants (78.02). These results in the same trend as the results obtained previously by (29). From the previous by results obtained, one can record that chicory roots could be considered as a good source of fiber, so it can be used as an alternative ingredient to fats in many processed foods.

Chemical composition of prepared beef burger

Table (2) showed that chemical composition of the cooked burger formulated with chicory roots powder, the chemical analysis of cooked burger showed that the percentage of moisture, protein, ash, crude fiber and available carbohydrates content were increased by increasing the amounts of chicory roots powder replacement in the burger. The increment of moisture content may be due to the capability of chicory roots powder rich with fiber to hold more water via preparation and cooking process. Meanwhile, the increment in other constituents may be a reflection of the quantity of these constituents in chicory roots.

On the other hand, the data in the same table revealed that ether extract content values in cooked burger were decreased significantly with chicory roots powder addition ($p \leq 0.05$) in comparison with the control sample. Maximum ether extract content percentage was noticed in control sample while, treatment contained (CRP) with 75% of animal fat showed the minimum percent. These obtained results were in harmony with those reported by Gök, Akkaya (7), Kılınççeker and Kurt (26) and Yousefi, Zeynali (27) who stated that beef burger integrated with different types of fat replacers were highly in some constituents such as moisture, ash, protein, fiber and available carbohydrates contents and lower in fat than in the control group.

Burger cooking properties

Moreover, data in Table (3) revealed that burger samples which replaced by chicory roots have cooking loss percentages lower than control. This decrement is due to the ability of chicory roots fiber to hold a large amount of water. There was a significant decrement in the loss via cooking process as a function of the increment in fat substitution level with chicory roots. Also, the results declared that adding chicory roots showed a positive influence on burger cooking yield. These results are in agreement with Kassem and Emara (30) and Namir, Siliha (31) who stated that there was a decrement in the cooking loss values of low fat burger when the levels of high fiber substances was increased.

Preventing shrinkage considered as one of the most important factors to maintain the quality levels of burgers because some consumers related to shrinkage and adding a high amount of water. Control beef burger sample had a high percentage of shrinkage after cooking process in a comparison with burger integrated with

chicory roots powder. These results are in conformity with the finding stated by Namir, Siliha (31).

Feeder number is applied to assess the meat products physical characteristics. Feeder number was 0.70 for control samples, which decreased gradually with the increment of chicory roots powder level. It was for all laboratory samples was lower than 4.0. as stated by Pearson (32) who recorded that feeder number in good products should be lower than 4.0.

Sensory evaluation

In the present study, the sensory evaluation of cooked burgers containing Chicory roots powder with 25%, 50% and 75% of control sample fat were recorded in Table (4).

Concerning the data in Table (4), one can be noticed that there were a slightly difference between control sample and that contained chicory roots powder with percentages of 25%, 50% and 75% of animal fat for all sensory characteristics. While the sensory scores of burger contained date chicory roots powder with ratio of 75% of fat were low compared with control sample, however they were in the acceptable limits (more than 6).

Conclusion

Chicory roots powder is considered as a rich source of fiber so that it can be used as fat replace in beef burger. Also, this study revealed that substituting 75% of animal fat in burger with chicory roots powder showed manufacture no negative effects on physical and cooking quality of processed burger.

Table 1: Gross chemical composition of chicory roots powder (% on dry weight basis)

Component	Chicory roots powder
Moisture (%)	6.84±0.89
Protein (%)	9.01±0.93
Ash (%)	5.60
Ether extract (%)	1.60
Crude fiber (%)	5.92

Table 2: Proximate chemical composition of burger with different concentrations of chicory roots powder as a fat replacer (on dry weight basis)

Treatments / Component%	Cooked burger			
	Control	CRP 25% of fat	CRP 50% of fat	CRP 75% of fat
Moisture	32.09^{b}	30.15^{d}	31.33^{c}	35.12^{a}
Crude protein	26.17^{d}	28.00^{c}	28.27^{b}	28.52^{a}
Ether extract	20.01^{a}	16.54^{b}	11.97^{c}	7.63^{d}
Ash	1.97^{c}	1.99^{c}	2.10^{b}	2.19^{a}
Crude fiber	1.23^{d}	2.98^{c}	3.78^{b}	4.21^{a}
available carbohydrates	50.62^{c}	50.49^{cd}	53.88^{b}	57.45^{a}

CRP means chicory roots powder, Values followed by the same letter in the same column are not significantly different at $P \leq 0.05$.

Table 3: Cooking properties of burger with different concentrations of chicory roots powder as a fat replacer

Treatments Properties	Control	CRP 25% of fat	CRP 50% of fat	CRP 75% of fat
Cooking yield (%)	47.14[d]	53.08[c]	57.82[b]	61.90[a]
Cooking loss (%)	52.46[a]	46.92[b]	42.18[c]	37.70[d]
Shrinkage (%)	25.15[a]	21.86[b]	18.89[c]	15.89[d]
Feder number	0.70[a]	0.59[b]	0.57[b]	0.64[b]

CRP means chicory roots powder

Values followed by the same letter in the same row are not significantly different at $P \leq 0.05$.

Table 4: Effect of Chicory roots powder percentage as a fat replacer on the sensory properties of burger*

Treatments Sensory	Control	CRP 25% of fat	CRP 50% of fat	CRP 75% of fat
Taste	8.0[a]	7.23[b]	7.05[b]	6.99[bc]
Colour	8.04[a]	7.20[b]	7.11[c]	6.95[c]
Odour	8.13[a]	7.14[b]	7.09[c]	6.96[cd]
Texture	8.12[a]	7.10[b]	7.07[c]	6.88[d]
Tenderness	8.21[a]	7.05[b]	7.01[b]	6.70[c]
Total acceptability	8.1[a]	7.14[b]	7.06[c]	6.89[d]

*All data are the mean±SD of twenty replicates. Mean followed by different letters in the same row differs significantly ($P \leq 0.05$)

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