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Comparative Evaluation of the Chemical, Physical and Microbiological Characteristics of Beef and Ostrich Meat Burger

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ABSTRACT

Ostrich meat is gradually becoming recognized as an alternative to red meat now a days. The main objectives of this study were to evaluate the quality characteristics of burger processed from the meat of ostrich and beef, to investigate the existence of microbial growth on a burger from the meat of ostrich and beef as well as possible environmental contaminants. The Ostrich and beef meat were prepared and stored frozen. The burger was processed in the laboratory and analyzed for chemical composition (crude protein, moisture, fat, and ash). Physical properties (water holding capacity, cooking loss) and microbiological analysis were done also. The findings of this study revealed that chemical composition of burgers from ostrich and beef had highly significant differences ($p \leq 0.01$) in moisture content, crude protein, lipids, and ash among all products. The physical attributes of burgers revealed that there were highly significant differences ($p \leq 0.01$) among all types of products. The Burger microbiological showed that there were highly significant differences ($p \leq 0.01$) in all parameters without E. coli and pseudomonas, which had no significant differences (NS) among all types of burgers. The study recommended that ostrich meat can be used as an alternative to beef meat.

KEYWORDS: *Meat, Ostrich, Beef, Burger*

INTRODUCTION

Considering the tendency of producing "healthy food" and a healthy way of life, people aim at consuming meat with a high biological value, high percentage of full protein, and low percentage of fat and cholesterol. The ideal solution is ostrich meat, Sales *et. al*., (1996). Ostrich meat is gradually becoming recognized as an alternative red meat lower in fat than beef or chicken, Rebecca and William (1995). Ostrich meat burger can compete in well regulated and competitive international markets; therefore, food quality and safety are of the utmost importance. At the same time, the production process must be well controlled to be cost - effective. Losses in meat yield through bruising and trimming, as well as a high initial microbial load that causes a decrease in shelf-life, are thus undesirable.

According to Hoffman *et al*. (2005), meat from ostriches fed a standard diet contains 21.65, 1.95, and 1.2% protein, fat, and ash, respectively. Similar values regarding to protein and ash were recently reported by Majewska *et al*. (2009). In their studies, ten different muscles were compared, and all of them had similar content of dry matter (23.3-24.5%), protein (20.6-21.7%), and ash (1.07-1.17%). In turn of fat content is more differentiated among muscles (0.90-1.34%) – (selected muscles) – being lower than in other species (beef – 4.6% or chicken – 4.3% (Sales 2002). It should be noted that in a study by Sales (2002), the fat content of ostrich meat was lower and varied from 0.2 to 0.71g/100g of edible meat, still as emphasized by Majewska *et al*.(2009), the lipid content depends on the method of the analysis, with different solvents used for extraction causing different results (Jensen 2004). According to Falvela (2004), ostrich meat is rich in polyunsaturated fatty acids and has low levels of saturated fat and sodium, which making it a healthy alternative to other red meats.

When consumption of ostrich meat shows increasing tendency, improvement of its hygienic safety and extension of shelf-life is crucial, both for the local markets and for export Gonzalez-Montalvo *et al*., (2007).

The objective of the current work is to study the quality characteristics of burger processed from meat of ostrich and beef. (chemical composition, physical proprieties and microbial load), compared to products made from beef and meat with that of wildlife.

Materials and methods

Food materials

Ostrich meat was obtained from Ostrich Nile Farm at Alelafoon (in Khartoum State, Sudan). And then Frozen in deep Freezer and transported to Almanagil. Beef meat was obtained from Almanagil local market in Sudan. The Ostrich and beef meat were stored and frozen. The additional materials needed in the formulation such as spices, salt, potatoes, onion, garlic, Chick Peas, milk Powder, Bread crumb, and Rice, were obtained from local markets.

Meat and additives preparation

Stored ostrich and beef meat were thawed overnight, sliced, and ground using a meat grinder. Chickpea was soaked for about one hour in one Litter of cold water. Potatoes were blanched and then ground. White Rice was soaked for one hour in one Litter of cold water. Spices were cleaned and ground.

Burger processing

Two types of the burgers were processed in the laboratory using two types of meat (Ostrich and beef) with the same ingredients (Beef fat, chickpeas, rice, water, salt, onion garlic, Bread crumb, skim Milk powder, and seasoning mixture). All ingredients were mixed and then formed using a burger-making machine (compressor). The average weight of the burger piece was 65 grams.

Table (1) Burger formulation

Component	Percentage
lean meat	76.9
Fat	3.9
Chick pea	5.4
Rice	1.7
Potatoes	1.6
Spices	1.5
Salt	1.4
Skim Milk powder	1.5
Ice water	1.5
Color	0
Bread crumb	3.1
Onion	1.5

Proximate analysis

Proximate chemical composition for determining the moisture, crude protein, fat (ether extract) and ash of the sample was done according to A.O.A.C. (2002).

Physical properties

Cooking loss and Water holding capacity

The cooking loss was determined according to Honikel (1998) and Water holding capacity (WHC) determination was done according to the method of Babiker and Lawrie (1983).

Microbial analysis

Microbial load in the burger from beef and ostrich meat were assessed, which includes the identification of total viable counts, coliforms, yeast and mold, Pseudomonas, *E. coli, Salmonella sp*, *Staphylococcus aureus*. (this work was done in microbiology laboratory)

Statistical analysis

All statistical analysis was done by using the computer with SPSS program Ver. (17, 2008) and Duncan multiple range tests were used to detect the difference between means.

Results and Discussion

Chemical composition of Burger

Moisture

Table (2) shows that the moisture of burgers processed from ostrich and beef was 59.69%, 59.06%% respectively. There were highly significant differences ($P \leq 0.01$) in moisture between ostrich and beef. The higher moisture content was found in the ostrich burger, while the lower moisture content was recorded in the beef burger. This findings in the beef burger were lower than that of Abdelkareem (2010), who observed that moisture content was (72.62%) also is lower than Yousif (2008), who found that moisture percentage was (61.8%). The results were higher than that found by Abdelmageed *et al*. (2014), who reported that beef burgers moisture was 53.92%. In the present study, ostrich burger shown very different moisture percentage (59.69%) which is lower than that observed by Vera Lúcia *et al*. (2012) .This may be due to different types of binder materials.

Crude protein (CP)

Table (2) Shows that the CP of burgers processed from ostrich and beef were 19.25%, 14%, respectively. There were highly significant differences ($P \leq 0.01$) in CP between ostrich and beef. The higher CP was observed in ostrich burger, while the beef burger was recorded the lower protein. The findings of CP of ostrich burger in this study agreed with Vera Lúcia *et al*., (2012), who was founding that CP of ostrich burger was (19.00%) while beef burger of CP in this study was similar to that found by Abdelmageed *et al.* (2014), who reported that beef burgers protein was (14.76%). Our results were disagree with Abdelkareem (2010) who reported that CP was (18.57%), it was higher than this study, also results were in contrast with that of Yousif (2008) who observed that CP is higher (22.88%). These differences may be due to differences in binder and filler used.

Either Extract of fat (E.E)

Table (2) shows that the E.E of fat for burgers processed from ostrich and beef were 2.75%, 3.70%, respectively. There were highly significant differences ($P \leq 0.01$) in E.E of fat among all types of products. The higher fat was observed in the beef burger, while the lower fat was found in the ostrich burger.

The findings were lesser than that obtained by Abdelmageed *et al.*, (2014) who reported that the Fat content of the beef burger was (22.62%), also lower than that reported by Abdelkareem (2010) who pointed out that the Fat content of beef burger was (4.28%), also Yousif (2008) found (8, 82) while the findings in ostrich burger were higher than that observed by Vere Lúcia *et al*. (2012), who reported (1.7%). Fat content did not exceed 30% (maximum amount stipulated in the FAO (2008) in all tested burger samples.

Ash

Table (2) shows that the ash contents of burgers processed from ostrich and beef were 2.92%, 3.07%, respectively. There were highly significant differences ($P \leq 0.01$) in ash between ostrich and beef. The higher ash was observed in the beef burger, while the ostrich burger had recorded the lower ash value. These findings were greater than that obtained by Abdelmageed *et al*. (2014), who reported that the Fat content of beef burger was (2.52 %) and Abdelkareem (2010) pointed out that the Ash percentage was (2.86%), while Ash ostrich burger in this study was lower than that observed by Vera Lúcia *et al*., (2012) who figured out that Ash of ostrich burger was (3.00%).

The proximate analysis of locally processed beef burgers have been reported by many investigators Babji and Letchumanan (1989) and Cristy *et al*. (2012).

Table (2) Average values (Means ± SE) of Chemical Composition for Burger of Ostrich and Beef

Variables	Over All	Burger		Sig
		Ostrich	Beef	
Moisture %	59.38±.29	59.69±.41[a]	59.06±.41[b]	**
Crude protein %	16.63±.004	19.25±.006[a]	14.00±.006[b]	**
Ether extract of Fat %	3.23±.004	2.75±.006[a]	3.70±.006[b]	**
Ash %	3.00±.01	2.92±.02[b]	3.07±.02[a]	**

- * The differences between mean of quantitative parameters are marked by various letters in the same raw are significant ($P \leq 0.05$).
- ** mean there is a highly significant differences ($P \leq 0.01$).

Physical Properties for Burger of Ostrich and Beef

Water Holding Capacity (W.H.C)

Table (3) Shows that the W.H.C of burgers processed from ostrich and beef were 2.56, 3.52 respectively. There were highly significant differences ($P \leq 0.01$). The higher W.H.C was observed in the beef burger, while the ostrich burger was recorded the lower W.H.C content. These findings in the beef burger were less than that found by Abdelkareem (2010) who observed that WHC of beef burger was (68.26%) however, these findings is greater than that found by Yousif (2008) were (1.48%) .

Cooking loss

Table (3) Shows that the cooking loss of burgers processed from ostrich and beef were 34.2, 38.41 respectively. There were significant differences ($P \leq .01$) in cooking loss between the ostrich and beef burger. The higher cooking loss content was recorded in the beef burger, while the ostrich burger was recorded the lower cooking loss. These findings were greater than that obtained by Abdelkareem (2010), who found that the cooking loss was (9.69%) and Yousif (2008) reported the cooking loss was (31.34%) was lower than our study.

Table (3) Average values (Means ± SE) of some Physical Properties for Burger of Ostrich and Beef

Variables	Over All	Burger		Sig
		Ostrich	Beef	
W.H.C	3.04±.004	2.56±.006[b]	3.52±.006[a]	**
Cooking Loss	36.27±.004	34.12±.006[b]	38.41±.006[a]	**

- * The differences between mean of quantitative parameters are marked by various letters in the same raw are significant ($P \leq 0.05$).
- ** mean there is a highly significant differences ($P \leq 0.01$).

Microbiological Properties for Burger of Ostrich and Beef

Escherichia coli *(E. coli)*

Table (4) shows that the E. coli of burgers processed from ostrich and beef were zero, there were no significant differences in E. coli among burger. The result of this study in the beef burger is disagree with Edward et al. (2013), who were studied the bacteriological quality of hamburger patties from fast –food restaurant in Umuahia, Nigieria and stated out that the E. coli content was present.

Pseudomonas:

Table (4) Shows that the pseudomonas of burgers processed from ostrich and beef were zero, there were no significant differences in pseudomonas between the ostrich and beef burgers. In the present study Pseudomonas content is agreed with the result reported by Edward et al. (2013), who were found that Pseudomonas in the beef burger was absent which studied the bacteriological quality of hamburger patties from fast –food restaurant in Umuahia, Nigieria

Staphylococcus aureus

Table (4) shows that the Staphylococcus of burgers processed from ostrich and beef were 0.00, 4x102 (CFU/g), respectively. There were highly significant differences ($P \leq 0.01$) in Staphylococcus among the burgers. The higher Staphylococcus was found to be in beef burger, while the Staphylococcus was not recorded in the ostrich burger. In the present study the Staphylococcus aureus was in line with the result of Edwards et al. (2013), who were found that staphylococcus aureus was present when studied the bacteriological quality of hamburger patties from fast –food restaurant in Umuahia, Nigieria.

Total coliform

Table (4) shows that the total coliform of burgers processed from ostrich and beef were 13.92 (MPN/g), 18.33 (MPN/g), respectively. There were highly significant differences ($P \leq 0.01$). The higher total coliform was observed in the beef burger, while the ostrich burger was recorded the lower total coli form content. On the other hand, the samples were contented lower coli forms load which in fall within the confidence limits of (SSMO, 2001) that reported acceptable microbiological limits (50.0 cfu/g), and the level of maximum count as (5×102 cfu/g).

Yeast and molds

Table 4.6 shows that the yeast and molds of burgers processed from ostrich meat and beef were 0.00 and 5x102 (cfu/g) respectively, there were highly significant differences ($P \leq .01$) in yeast and molds among burgers. The higher yeast and molds were observed in the beef burger, while yeast and molds were not recorded in the ostrich burger. The beef burger samples had contented a number of yeast and molds higher than the range of (SSMO, (2001which requires presence of the less than 6.0 cfu/g mold in processing meat.

Total viable count

Table 4.6 shows that the total viable count of burgers processed from ostrich and beef were 3.53x104 (CFU/g) and 4.53x106 (CFU/g), respectively, there were highly significant differences ($P \leq .01$) in total viable count between burgers. The higher total viable count was found to be in the beef burger, while the ostrich burger was showed the lower total viable count. These results were acceptable as they fall within the confidence limits (107 cfu/g) of total viable counts of (chilled and unfrozen) fresh meat products like burger, sausage, etc.) Required by the Sudanese Standardization Metrology Organization SSMO (2001).

Table (4) Average values (Means ± SE) of Microbiological Properties for Burger of Ostrich and Beef

Variables	Over All	Burger		Sig
		Ostrich	Beef	
E. coli (MPN/g)	0.00±0.00	0.00±0.00	0.00±0.00	NS
Pseudomonas (c fu /g)	0.00±0.00	0.00±0.00	0.00±0.00	NS
Staphylococcus (cfu /g)	2×10^{2}±.13	0.00±0.00	4×10^{2}±.19^{a}	**
Total coli form (MPN/g)	15.67±.65	13±.92^{b}	18.33±.92^{a}	**
Yeast and Mould (cfu/g)	2.50×10^{2}±.34	0.00±0.00	5×10^{2}±.49^{a}	**
Total viable count (cfu/g)	2.28×10^{6}±.88	3.53×10^{4}±1.24^{b}	4.53×10^{6}±1.24^{a}	**

- * The differences between mean of quantitative parameters are marked by various letters in the same raw are significant (P≤ 0.05).
- ** mean there is a highly significant differences.
- N.S.: Not significant

Conclusion

The chemical composition of burgers showed that the ostrich burger had the highest percentages in crude protein and moisture while the beef burger recorded the highest percentages in ash and E.E of fat.

The microbial load of beef burger observed the higher count of *Staphylococcus aureus*, yeast and mold, total coliform, and total viable count compared to the ostrich burger had lower count of Staphylococcus *aureus*, yeast, and mold, total coliform and total viable count, while *E. coli* and *Pseudomonas* were not detected in the ostrich burger and beef burger.

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