

COMPARATIVE STUDY BETWEEN THE EFFECTS OF DIFFERENT NATURAL ANTIOXIDANTS ON THE QUALITY OF REFRIGERATED BUFFALO MEAT PRODUCT

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Abstract

This investigation was carried out in order to make a comparative study on the effect of different natural antioxidants extracts on the quality of buffalo meat product stored for 28 days at refrigeration condition. The data showed that the samples treated with the extract had higher moisture content, pH, WHC, and sensory evaluation values, while they had lower TBA values, and total bacterial count than the untreated one.

Key words: Natural antioxidant extracts, buffalo meat product, cold storage

INTRODUCTION

Lipid oxidation and bacterial contamination are the main factors that determine food quality loss and shelf life reduction. Therefore, delaying lipid oxidation and preventing bacterial cross-contamination are highly relevant to food processors [8]. Meat as a food has a complex physical structure and chemical composition that is very susceptible to oxidation [22], [19]. The oxidative stability of meat depends upon the balance and the interaction between endogenous anti- and pro-oxidant substances and the composition of substrates prone to oxidation including poly unsaturated fatty acids (PUFA), cholesterol, proteins and pigments [22], [19]. During processing, distribution, and storage, meat products undergo deterioration from chemical and microbiological processes [12]. Oxidation is a major cause of that deterioration because of its negative effects on organoleptic qualities (flavor, color, etc.). In addition, it can also have a marked negative effect on nutritional value, and could be responsible for the production of toxic compounds [17]. Due to the negative effects of lipid oxidation;

addition of synthetic antioxidants has been effective for their low cost, high stability, and effectiveness. The use of antioxidants in lipid containing foods is one method to minimize rancidity, retard the formation of toxic oxidation products, maintain nutritional quality and increase the shelf life of food products. However, the use of such compounds has been related to health risks resulting in strict regulations over their use in food products and this has stimulated research for alternative antioxidant sources [14]. With increased consumer concerns about the chemicals in their foods, processors are looking for more natural ways to protect their products. The use of natural additives in preference to synthetic substances for the stabilization of fat-containing food stuff have been increased and attracted considerable interest of researchers [19], [5]. Several studies have been carried out by different researchers applying natural antioxidants of plant origin to meat products [20]. The increased interest in natural antioxidants has led to the antioxidant evaluation of many species of fruits, vegetables, herbs, spices and cereals [22], [16]. Several natural antioxidants have been tested in meat products; black pepper, extract of rosemary, ground fresh leaves of rosemary and sage. They have reported to inhibit lipid oxidation in beef hamburgers [1], [13]. Herbs and

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spices have been used for their antimicrobial properties in preventing food deterioration and pathogenic diseases [11]. *Moringa oleifera* is considered as an important source of naturally occurring antioxidant and antimicrobial substances [7], [10]. Therefore, there is growing interest in separating these plant antioxidants and using them as natural antioxidants.

The objective of this investigation is to make a comparative study between the effects of different natural antioxidants on the quality of buffalo meat product during cold storage.

MATERIAL AND METHODS

Preparation of the extracts: Black cumin, rosemary were obtained from a local market in El- Minia, Egypt, while, peppermint and moringa oleifera leaves were obtained from Minia University farm, Egypt. The leaves were thoroughly washed and dried in the air for two days. The spices and the dried leaves were separately powdered for 60 mesh. One hundred grams of each dried powder was extracted with (100 ml) ethanol solution (50%) on a lab line orbit shaker at 60Xg for 2h. The solutions were centrifuged at 1800Xg followed by filtration using Whatman No 1 filter paper. The final concentration of each stock solution was 1g/1 ml.

Preparation of buffalo meat product: The buffalo meat (bottom round, 15 Kg) used in this study was obtained from the local market one hour after slaughter. The meat was trimmed, packed in low density polyethylene bags and held at 4 ± 1 °C for 24 hours, cut into cubes and minced twice with a meat grinder using 8 mm (coarse) and 3 mm (fine) plates simultaneously to obtain ground meat. Buffalo meat product was prepared according to the following recipe in (table 1).

All the ingredients were mixed well, and divided into five equal portions. The first portion was left with no additives as control, while black cumin, rosemary, dried moringa leaves, dried peppermint powders extracts were added to the other four portions simultaneously in the ratio of 1 %.

Each portion was divided into small balls 50 g each, then formed into a burger-like

shape 10 cm diameter and 0.5 cm thickness, and packaged in low density polyethylene bags under refrigerated condition till analysis Fig. 1.

Analytical methods: Moisture, crude protein, ether extract, ash, and crude fiber were determined according to the methods of [3].

pH measurement: A slurry was prepared by blending the meat product (5g/50ml distilled water). The pH of this slurry was measured by using the glass-electrode method according to [2].

Thiobarbituric acid (TBA) value: Control and extract treated buffalo meat product samples were tested separately. TBA-reactive substances were measured using the method of [9]. Colorimetric absorbance at 530 nm was measured using a Spectronic 710 Spectrophotometer. Readings were converted to mg malonaldehyde /1000g meat product and reported as TBA values (mg TBA/1000g meat product).

Determination of expressible water (EW) and water holding capacity (WHC): Expressible water (EW) was determined according to [1], whereas, the water holding capacity (WHC) was calculated.

Microbiological test: Total aerobic count of control and treated buffalo meat product was made as log (CFU/g) according to the methods described in the standard methods of [4], [21].

Sensory evaluation: Sensory evaluation for color, flavor, juiciness, and overall acceptability for the cooked control and extract treated buffalo meat products were carried out in order to determine the consumer acceptability for the product according to the methods described by [15]. Ten judges were participated in this test. A numerical hedonic scale ranged between 1 and 10 (1 for very bad, and 10 for excellent) was used for the evaluation.

Table 1 Formulation of buffalo meat product

Ingredient	%
Ground buffalo meat	84
Minced fat tissue	10
Salt	2
Black pepper powder	1
Onion powder	1
Crushed ice (water)	2

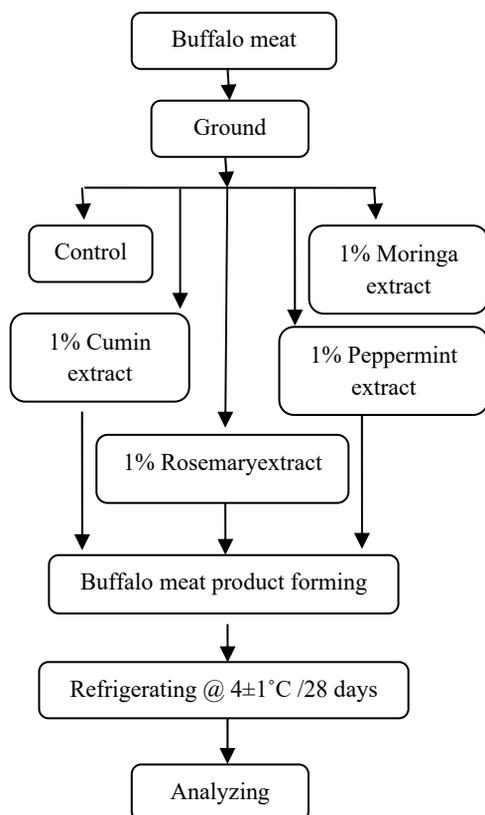


Fig. 1 Flow diagram of production of buffalo meat product stored under refrigerated condition

RESULTS AND DISCUSSION

Plant extracts prepared from different plant materials are rich in phenolics and provide a good alternative to synthetic antioxidants. Thus most of the recent research has been directed towards

identification of novel antioxidants from natural sources, particularly of plant origin. These natural antioxidants have been extracted from different plant parts like leaves, roots, stems, fruits, seeds and bark.

The application of plant extracts as antioxidants has been studied extensively in different types of meat and meat products. Muscle foods have low oxidative stability and are very susceptible to rancidity during production and storage. Numerous studies have indicated that lipid oxidation in meat and meat products may be controlled or minimized through the use of antioxidants. Table 2 illustrates the chemical composition and the energy value (Kcal/100 gm) of the control and the extracts treated buffalo meat product. The data showed that there are no differences in the protein, ether extract, ash, fiber, and energy values for the control or the extracts treated samples. Whereas, the addition of the extracts caused a little increase in the moisture content for the treated samples due to the amount of water in the extract solution (50%). Lipid oxidation is a major cause of chemical spoilage in food systems. It is considered as one of the major causes of quality deterioration of processed meat. The application of plant extracts as antioxidants has been studied extensively in different types of meat and meat products. These studies show promising results regarding the use of plant extracts as antioxidants in meat. Those extracts inhibit lipid oxidation and degradation of meat pigments, and thus help to delay the onset of rancid flavors and stabilize the color of meat.

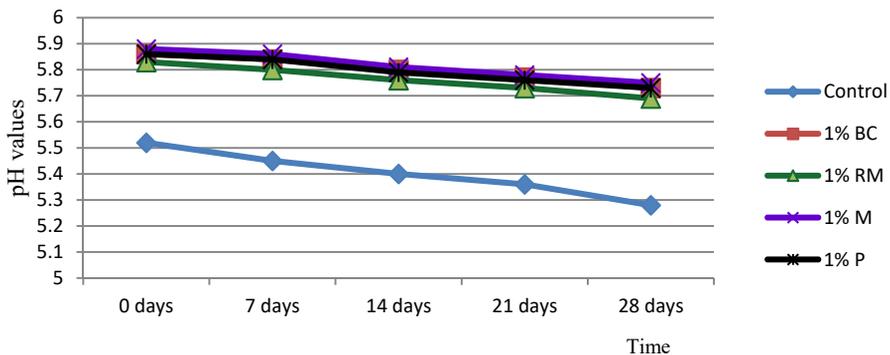
Table 2 Chemical composition of control and extracts treated buffalo meat product (wet basis %)*

Component	Control	1% Black cumin extract	1% Rosemary extract	1% Moringa extract	1% Peppermint extract
Moisture	70.07	70.51	70.48	70.46	70.49
Protein	14.91	14.85	14.81	14.85	14.80
Ether extract	12.89	12.87	12.86	12.81	12.80
Ash	1.88	1.83	1.84	1.77	1.80
Fiber	0.19	0.15	0.11	0.10	0.12
Energy (Kcal/100g)	176	175	175	175	174

* Means of three determinations

Figures 2 & 3 clearly illustrate the effect of natural antioxidants extracts and cold storage time on the pH and TBA values for the buffalo meat product. The data demonstrate that there was a decrease in the pH, and an increase in the (TBA) values for all the samples under investigation along with the storage period. The reduction in the pH values or the increment in the (TBA) values were much higher for the control sample compared with the extracts treated ones. The reduction in the pH and the increment in the (TBA) values could be due to the effect of natural antioxidants which retarded the formation of free fatty acids. In addition, it can actively scavenge free radicals and thus prevent oxidation [17], [18]. The data also showed that the samples treated by black cumin and moringa leaves extracts had the lowest (TBA) values among the others. This comes in agreement with [6] who found that the application of moringa oleifera leaves extract in cooked goat meat patties stored under refrigerated condition has excellent antioxidant activity and retarded the lipid peroxidation of cooked goat

meat patties as measured by TBARS value. Table 3 illustrates the effect of natural antioxidant extracts and storage time at refrigeration condition on some physical parameters of the control and extracts treated samples of buffalo meat product. The data showed increase in the expressible water (EW) and decrease in the water holding capacity(WHC) values for the control sample, whereas, the extracts treated sample had no noticeable change in both (EW) and (WHC) values. This means that the addition of natural antioxidants extracts has increased the power of the protein matrix to bind the water. Table 4 illustrates the effect of natural antioxidants extracts and storage time (28days) at refrigerated condition on the total bacterial count for buffalo meat product. The data showed a positive relationship between the time of storage and the bacterial count for all samples. The rate of increment was the highest in the control samples compared with the treated ones. This is particularly evident for the inhibition effect of the natural antioxidants extracts on the growth of bacteria.



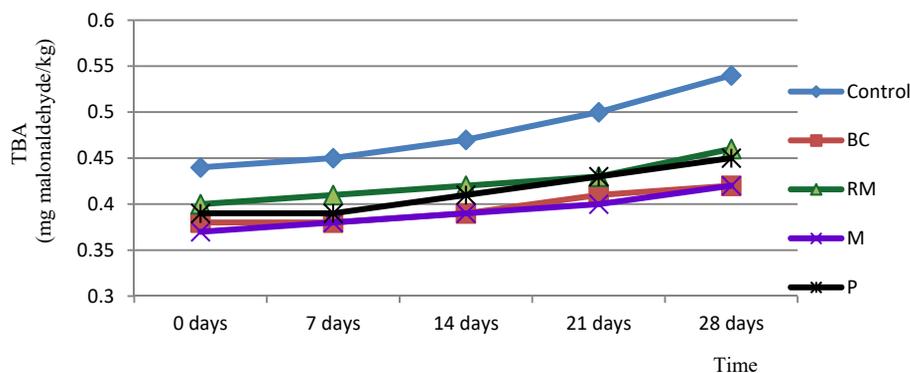
BC = Black cumin.

RM = Rosemary.

M = Moringa.

P = Peppermint.

Fig. 2 Effect of natural antioxidant extracts on the pH values of refrigerated buffalo meat product



BC = Black cumin. RM = Rosemary. M = Moringa. P = Peppermint.

Fig. 3 Effect of natural antioxidant extracts on the TBA values (mg malonaldehyde/kg) of refrigerated buffalo meat product

Table 3 Effect of natural antioxidant extracts and cold storage time on the expressible water EW and water holding capacity WHC of buffalo meat product*

Storage time (days)	Parameter	Control	1% Black cumin extract	1% Rosemary extract	1% Moringa extract	1% Peppermint extract
0	EW	56.87	56.01	55.98	55.97	56.00
	WHC	13.21	14.50	14.50	14.49	14.49
7	EW	56.89	56.01	55.96	55.96	55.98
	WHC	13.20	14.49	14.48	14.48	14.47
14	EW	56.92	55.99	55.95	55.94	55.95
	WHC	13.18	14.46	14.45	14.45	14.46
21	EW	57.01	55.95	55.92	55.93	55.94
	WHC	12.78	14.44	14.42	14.43	14.43
28	EW	57.17	55.93	55.88	55.90	55.91
	WHC	12.50	14.41	14.40	14.41	14.40

* Means of three determinations

Table 4 Effect of natural antioxidant extracts and cold storage time on the total bacterial count (log CFU/g) of buffalo meat product*

Storage time (days)	Control	1% Black cumin extract	1% Rosemary extract	1% Moringa extract	1% Peppermint extract
0	3.10	2.71	2.81	2.70	2.79
7	3.18	2.72	2.83	2.72	2.84
14	3.27	2.74	2.87	2.73	2.87
21	3.36	2.74	2.89	2.74	2.90
28	3.45	2.75	2.94	2.75	2.95

* Means of three determinations

Sensory evaluation of control and natural antioxidants treated extracts buffalo meat product stored for 28 days under refrigeration condition was illustrated in Table 5. The data showed that the addition of the extracts to the buffalo meat samples retarded the negative effect of storage time on the evaluation

values for color, flavor, juiciness, and overall acceptability compared to the control one. That means the addition of the extracts as natural antioxidants to the buffalo meat product had positive effect on the consumer preferences and increased their acceptability to the meat product.

Table 5 Effect of natural antioxidant extracts and cold storage time on the sensory evaluation of buffalo meat product *

Treatment	Panelists evaluations				
	Storage time (days)	Color	Flavor	Juiciness	Overall acceptability
Control	0	9.0	8.0	8.0	8.5
	7	8.5	8.0	7.5	8.5
	14	8.0	7.5	7.0	8.0
	21	7.5	7.0	6.5	7.5
	28	7.0	7.0	6.5	7.0
1% Black cumin extract	0	9.0	8.0	8.0	8.5
	7	9.0	8.0	8.0	8.5
	14	8.5	8.0	7.5	8.0
	21	8.5	7.5	7.5	8.0
	28	8.0	7.0	7.0	7.5
1% Rosemary extract	0	9.0	8.0	8.5	8.5
	7	8.5	8.0	8.5	8.5
	14	8.0	7.5	8.0	8.0
	21	8.0	7.5	7.5	7.5
	28	7.5	7.5	7.5	7.5
1% Moringa extract	0	9.0	8.0	8.5	8.5
	7	9.0	8.0	8.5	8.5
	14	8.5	7.5	8.0	8.0
	21	8.5	7.5	8.0	8.0
	28	8.0	7.5	8.0	8.0
1% Peppermint extract	0	9.0	9.0	8.5	9.0
	7	9.0	9.0	8.5	8.5
	14	9.0	8.5	8.0	8.5
	21	8.5	8.0	8.0	8.0
	28	8.5	8.0	8.0	8.0

* Means of three determinations

CONCLUSION

Based on the above findings, it was concluded that the use of natural antioxidant extracts at level of 1% improved the quality of the buffalo meat product stored for 28 days at refrigerated condition by delaying the oxidation of the product and preventing the growth of bacteria. The study also clearly indicated that the treatment by natural antioxidants extracts can be successfully used as a meat additive due to their strong effect in keeping quality and in improving the sensory characteristics of the product.

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