# EFFECT OF *MORINGA OLEIFERA* LEAVES EXTRACT ON QUALITY OF BUFFALO MEAT PRODUCT

**Mohamed A. Kenawi[1*], Sanaa M. Abd El-Hameed[1]**

*[1]Dept. Food Sci., Minia University, Egypt*

**Abstract**

*Moringa Oleifera Lam. (Moringaceae) leaves powder extract in three concentration levels 0.5%, 1%, and 2% was used as a natural antioxidant to study its effect on the quality of buffalo meat product. The data showed that there were no noticable differences between the treated and the control samples in the chemical composition, the expressible water, the water holding capacity, the cooking loss or the shrinkage values. The data also showed that the samples treated with Moringa leaves extract had lower TBA values and higher Feder values than the control ones. In the mean time Moringa leaves extract showed inhibiting effect on the growth of bacteria and increased the acceptability to the meat product.*

**Key words:** Moringa leaves extract, quality, buffalo meat product

## 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]. During production, processing, distribution, and storage, food undergoes deterioration from chemical and microbiological processes. Oxidation is a major cause of that deterioration because of its negative effects on organoleptic qualities (flavor, color, etc.) [12]. Oxidation of lipids can also have a marked negative effect on nutritional value, and could be responsible for the production of toxic compounds. Considering the need of extending the shelf life of meat products, various items in terms of antioxidant, preservatives and anti bacterial activity have been tried with varying degree of success [14], and [15]. In vogue of present national and international barriers regarding use of chemical food additives to food processing and preservation, the biological and plant origin food additives have got better significance and require emphasis for attention and study. In the recent years the interest in the application of naturally occurring antioxidant in muscle foods has amplified. The use of antioxidants like vitamin C and E had a significant effect in reducing oxidation of lipids and pigments of meat during storage [17]. In view of the fact that natural spices are widely used in a variety of food products, it is important to know the effects they have on the keeping qualities of such products. Several natural antioxidants have been tested in meat systems; black pepper, and extract of rosemary. Ground fresh leaves of rosemary and sage have also been reported to inhibit lipid oxidation in beef hamburgers [2], and [12]. Herbs and 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], and [10].

The objective of this investigation was to determine the potential effect of the application of three levels of *Moringa oleifera* leaves extract (0.5%, 1%, and 2%) on the quality of buffalo meat product.

## MATERIAL AND METHODS

### Moringa leaves powder extract:

The *Moringa oleifera* leaves were obtained from Minia University farm, Egypt. The leaves were thoroughly washed and dried in the air for two days, then powdered for 60 mesh. One

*Corresponding author:
mohamedkenawi@ymail.com
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hundred grams of dried Moringa leaves powder was extracted with (100 ml) ethanol solution (50%) on a lab line orbit shaker at 60Xg for 2h. The solution was centrifuged at 1800Xg followed by filtration using Whattman No 1 filter paper. The final concentration of the stock solution was 1 g /1 ml.

**Preparation of buffalo meat product:**

The buffalo meat (bottom round, 10 Kg) used in this study was obtained from a local market in El-Minia, Egypt, one hour after slaughter. The sample was trimmed, packed in low density polyethylene bags and held at 4±1°C for 24 hours, cut into cubes and minced with a meat grinder using 8 mm (coarse) and 3 mm (fine) plates simultaneously to obtain ground buffalo meat. Buffalo meat product was prepared according to the following recipe in (table 1).

All the ingredients were mixed well, then divided into four equal portions. The first portion was left with no additives as control, while dried Moringa leaves powder extract was added to the other three portions in the ratio of (0.5 %, 1 % and 2 %).

Each portion was divided into small balls 50 g each, then formed into a burger-like shape 10cm diameter and 0.5 cm thickness, and packaged in low density polyethylene bags under refrigerated condition till analysis.

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 |

**Analytical methods:** Moisture, crude protein, ether extract, ash, and crude fiber were determined according to the methods of [5].

**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 [4].

**Thiobarbituric acid (TBA) value:** Control and Moringa leaves 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 [2], whereas, the water holding capacity (WHC) was calculated.

**Cooking loss:** Cooking loss of the control and treated buffalo meat product samples were determined according to the method of [3] by using the following equation:

$$\% \text{ cooking loss} = \frac{RSW - CSW}{RSW} \times 100$$

Where;
RSW = Raw sample weight
CSW = Cooked sample weight

**Shrinkage value**: Shrinkage value of cooked samples was determined according to the method of [2] as follows:-

$$\text{Shrinkage value} = \frac{(R.T - C.T) + (R.D - C.D)}{(R.T + R.D)} \times 100$$

Where:
R.T = raw sample thickness
C.T = cooking sample thickness
R.D = raw sample diameter
C.D = cooked sample diameter

**Texture coefficient indices:** Texture coefficient indices (protein water coefficient PWC, and protein water fat coefficient PWFC), for the formulated buffalo meat product were calculated according to the methods described by [19] as follows:-

$$PWC = \frac{\% \text{ Protein}}{\% \text{ Moisture}}$$

$$PWFC = \frac{\% \text{ Protein}}{\% \text{ Moisture} + \% \text{ Fat}}$$

**Feder value:** Feder value for the samples was calculated according to the method of [16] as follows:-

$$\text{Feder value} = \frac{\text{\% Moisture content}}{\text{\% Organic non fat content}}$$

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

**Microbiological test:** Total aerobic count of buffalo meat product was made as log (CFU/g) according to the methods described in the standard methods of [6].

**Sensory evaluation:** Sensory evaluation for color, flavor, juiciness, and overall acceptability for the cooked control and Moringa extract treated buffalo meat product were carried out in order to determine the consumer acceptability for the product according to the methods described by [13]. 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.

## RESULTS AND DISCUSSION

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 nutritional value (Kcal/100 gm) of the control and the Moringa leaves extract treated buffalo meat product before and after cooking. The data showed that the addition of Moringa leaves powder extract in three levels (0.5%, 1%, and 2%) as a natural antioxidant to the buffalo meat product did not affect too much in the protein, ether extract, ash, and fiber contents for the control or the Moringa extract treated samples. Whereas, it caused a little increment in the moisture content for the treated samples due to the amount of water in the extract solution (50%). Same trend was shown in the nutritional values for the treated and untreated samples.

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

| Component | Status | Control | 0.5% Moringa extract | 1% Moringa extract | 2% Moringa extract |
|---|---|---|---|---|---|
| Moisture | Raw | 70.32 | 70.36 | 70.42 | 70.50 |
| | Cooked | 51.98 | 52.12 | 52.13 | 52.28 |
| Protein | Raw | 14.86 | 14.85 | 14.81 | 14.81 |
| | Cooked | 24.12 | 24.18 | 24.20 | 24.21 |
| Ether extract | Raw | 12.86 | 12.87 | 12.86 | 12.86 |
| | Cooked | 20.86 | 20.89 | 20.92 | 20.93 |
| Ash | Raw | 1.82 | 1.83 | 1.84 | 1.82 |
| | Cooked | 2.42 | 2.44 | 2.47 | 2.46 |
| Fiber | Raw | 0.14 | 0.15 | 0.15 | 0.15 |
| | Cooked | 0.25 | 0.27 | 0.25 | 0.27 |
| Energy (Kcal/100g) | Raw | 175 | 175 | 175 | 175 |
| | Cooked | 283 | 285 | 285 | 285 |

*Means of three determinations

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. Table 3 clearly illustrates the effect of *Moringa oleifera* leaves powder extract on the pH, the (TBA) values and the aerobic total bacterial count (TPC) for the control and treated samples of buffalo meat product. The data demonstrate that there is an increase in the pH values and a decrease in the (TBA) values for the Moringa extract treated buffalo meat product compared to the control one. The increment in the pH and the reduction in the (TBA) values could be due to the effect of natural antioxidants which retarded the formation of free fatty acids. In addition, the extract of Moringa leaf can actively scavenge free radicals and thus prevent oxidation [18]. The data also showed a negative relationship

between the natural antioxidant treated samples and the total bacterial count compared with the control one. The rate of reduction was the highest in the sample contains 2% Moringa leaves extract compared with the other two levels 0.5% and 1%. This is particularly evident for the inhibiting effect of Moringa leaves extract on the growth of bacteria.

Table 3 Effect of Maringa leaves extract on the pH, TBA values and total plate count (TPC) of buffalo meat product *

| Parameter | Control | 0.5% Moringa extract | 1% Moringa extract | 2% Moringa extract |
|---|---|---|---|---|
| pH | 5.50 | 5.80 | 6.00 | 6.00 |
| TBA (mg malonaldehyde/kg) | 0.45 | 0.41 | 0.36 | 0.31 |
| TPC (logCFU/g) | 3.10 | 3.00 | 2.80 | 2.70 |

*Means of three determinations

Table 4 shows the effect of Moringa leaves powder extract and cooking treatment on some physical parameters of the control and treated samples of buffalo meat product. The data showed that all samples experienced a reduction in weight, thickness, and diameter as a result of cooking treatment. Regarding the expressible water (EW) and water holding capacity (WHC) values, the data showed that the addition of Moringa leaves extract with three different levels to the buffalo meat product has no great effect on the values of (EW) or (WHC). Same trend has been shown for the cooking loss or the shrinkage values.

Table 4 Weight, thickness, diameter, expressible water (EW), water holding capacity (WHC), cooking loss, and shrinkage value of control and Maringa leaves extract treated buffalo meat product as affected by cooking *

| Parameter | Status | Control | 0.5% Moringa extract | 1% Moringa extract | 2% Moringa extract |
|---|---|---|---|---|---|
| Weight (g) | Raw | 50.00 | 50.00 | 50.00 | 50.00 |
| | Cooked | 31.60 | 31.90 | 32.00 | 31.90 |
| Thickness (cm) | Raw | 0.50 | 0.50 | 0.50 | 0.50 |
| | Cooked | 0.40 | 0.40 | 0.40 | 0.40 |
| Diameter (cm) | Raw | 10.00 | 10.00 | 10.00 | 10.00 |
| | Cooked | 7.80 | 7.80 | 7.60 | 7.65 |
| Expressible water EW | Raw | 55.96 | 56.08 | 56.09 | 56.10 |
| Water holding capacity WHC | Raw | 14.36 | 14.28 | 14.33 | 14.40 |
| Cooking loss % | Cooked | 36.80 | 36.20 | 36.00 | 36.20 |
| Shrinkage value % | Cooked | 2.10 | 2.10 | 2.29 | 2.24 |

*Means of three determinations

The effect of Moringa leaves extract and the cooking treatment on the texture coefficient indices, protein water coefficient (PWC), protein water fat coefficient (PWFC), and Feder value of buffalo meat product is shown in Table 5. The data showed that cooking treatment increased the (PWC) and the (PWFC) values for all samples. The data also showed no difference between the control and the Moringa leaves extract treated samples. The Feder value was one of the tests used for assessing the quality of meat products. The data illustrated that Feder values for the control samples (raw or cooked) were pretty close to the values for the Moringa leaves extract treated ones.

Sensory evaluation of control and Moringa leaves extract treated buffalo meat product *was* illustrated in Table 6. The data showed that the addition of Moringa leaves extract to the buffalo meat samples increased the evaluation values for color, flavor,

juiciness, and overall acceptability among the other samples. That means the addition of *Moringa oleifera* leaves extract as a natural antioxidant to the buffalo meat product had a positive effect on the consumer preference and increased their acceptability to the meat product.

Table 5 Effect of Maringa leaves extract and cooking treatment on texture coefficient indices (PWC %), (PWFC %), and feder value of buffalo meat product *

| Parameter | Status | Control | 0.5% Moringa extract | 1% Moringa extract | 2% Moringa extract |
|---|---|---|---|---|---|
| PWC % | Raw | 0.21 | 0.21 | 0.21 | 0.21 |
| | Cooked | 0.46 | 0.46 | 0.46 | 0.46 |
| PWFC % | Raw | 0.18 | 0.18 | 0.18 | 0.18 |
| | Cooked | 0.33 | 0.33 | 0.33 | 0.33 |
| Feder value | Raw | 4.69 | 4.71 | 4.73 | 4.76 |
| | Cooked | 2.10 | 2.12 | 2.13 | 2.15 |

PWC = Protein water coefficient PWFC = Protein water fat coefficient *Means of three determinations

Table 6 Sensory evaluation of control and Maringa leaves extract treated buffalo meat product*

| Treatment | Color | Flavor | Juiciness | Overall acceptability |
|---|---|---|---|---|
| Control | 6.8 | 6.7 | 6.2 | 6.8 |
| 0.5% Moringa ext. | 7.0 | 7.0 | 7.0 | 7.1 |
| 1% Moringa ext. | 7.3 | 7.2 | 7.0 | 7.5 |
| 2% Moringa ext. | 7.9 | 7.2 | 7.1 | 7.8 |

*Means of ten determinations

## CONCLUSION

Based on the above findings, it was concluded that use of *Moringa oleifera* leaves powder extract as a natural antioxidant at the concentrations of 0.5%, 1%, and 2% improved the quality of the buffalo meat product by reducing the TBA values. The study also clearly indicated that the treatment by Moringa leaves extract can be successfully used as a meat additive due to its strong effect in preventing the growth of bacteria and also in improving the sensory characteristics of the product.

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