Effect of Moringa Leaves Powder on the Chemical, Microbial and Sensory Evaluation of Catfish Burger

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Abstract:

Fish is considered as one of the cheapest sources of animal protein all over the globe. It provides protein, vitamins, minerals and omega-3 fatty acids for human diets. It represents one of the national income sources in Egypt. The Egyptian Fisheries Authority declared in 2020 that, the production of fish reached 1 million 920 thousand tons. Since African catfish is one of the fish species consumed in Egypt. This study was done to use the fresh (Nile Karmout) catfish (Claries gariepinus) to produce catfish burger, and study the effect of adding 1% of Moringa leaves powder to the formula on the chemical composition, microbiological stability, and sensory evaluation of the product. The data showed that the addition of 1% moringa leaves powder to the catfish burger caused reduction in the water holding capacity, and increased the cooking loss while reduced the number of the examined bacterial count and improved the sensory evaluation compared to the control samples.

Keywords: Catfish burger, moringa leaves powder, Nile Karmout.

Introduction:

Fish is one of the most important and cheapest sources of animal protein, minerals, and other required nutrients for human diet all over the world. It is considered as an important source of protein, vitamins, minerals and omega-3 fatty acids for the people of poor countries. Fish is characterized by being an easy-to-digest food that can be presented as a meal in many ways.

In Egypt, fish is one of the most important sources of national income. In addition, it is also considered as a source of safe protein that provides food needs and develops other industries. The Egyptian fisheries occupy more than 13 million acres, equivalent to about 150% of the agricultural land, which include seas, many lakes, the river Nile, and fish farms located in different parts of Egypt.

In a report issued by the Egyptian Fisheries Authority in 2020 confirmed that, Egypt's fish production currently has reached 1 million 920 thousand tons, of which 80% is from fish farming and 20% is from capture fisheries.

African catfish is one of the fish species most suitable for fish farming in the African continent, which have a high growth speed, resist environmental stress and resist handling stress during farming operations (Suleiman et al., 2009).

Its meat taste good and thus interest has developed in the cultivation of African catfish on a large scale on the African continent. In the Arab Republic of Egypt there are two species of catfish, they are:

1- African catfish Clarias gariepinus
2- Egyptian catfish Clarias anguillarum
The African catfish, Clarias gariepinus, is the most common species in the Arab Republic of Egypt.

Catfish (Clarias gariepinus) is one of the freshwater fish species that are well adapted to enclosed waters and resistance to handling and diseases. It is produced in large quantity especially in the Nasser's Lake, the first pond in Wadi El-Rayan Lake and along with the fish farming and other freshwater Lakes. Catfish is an extraordinary nutritious fish that contains large amounts of unsaturated fatty acids, vitamins, proteins, and minerals (Nelson et al., 2016). In addition, it has little or no saturated fat; and is low in carbohydrates.

Aref et al., (2018) determined the proximate composition of minced catfish fillet (Clarias gariepinus), and found that, the moisture content was 76.48%, ash content 1.22%, crude protein 19.88%, and Crude ether extract 1.63%. Whereas (Zhu et al., 2015), found that the chemical composition of untreated raw channel catfish fillets was 68.77±2.21%, 16.01±0.35%, 13.47±0.81%, and 1.10±0.05% for moisture, crude protein, crude ether extract and total ash contents respectively.

Ozogul et al., (2011), reported that the maximum TBA value, in good quality fish, is 5 mg malonaldehyde (MA/ kg), while fish with TBA value up to 8 mg (MA/ kg) can be consumed. Lipid oxidation in fish and seafood products can lead to development of off-flavors and odors, which indicates of quality loss.

According to the (EU, 1995), total volatile basic nitrogen (TVB-N) levels were found to be as effective and useful indicators to measure seafood spoilage. According to the European Commission who stated that, the (TVB-N) amounts can be used as indicator when sensory methods increment doubts about the freshness of seafood products.

Water-holding capacity, is intimately associated to the juiciness, texture, and other condition properties of fish and meat (Jiang et al., 2018). Water-holding capacity of fish meat muscles can be significantly affected by some processing methods such as freezing method (Jiang et al., 2018).

Moringa oleifera (Moringa oleifera Lam.) is considered as one of the important source of natural antioxidant, and antimicrobial agent (Dillard and German., 2000; and Hazra et al., 2012).

Its leaves have been described to be an excellent source of natural antioxidants and, thus, increase the shelf life of foods containing fat for the presence of many different types of antioxidant components such as flavonoids, ascorbic acid, carotenoids and phenolics (Al-Juhaimi et al., 2015).

Fish and other sea foods are extremely sensitive food products and are vulnerable to chemical and microbiological spoilage during processing or storage. Therefore, one or more adequate preservation methods are required to maintain the safety and quality and to extend the shelf life of such products (Hassoun and Çoban, 2017). Microorganisms are the major cause of deterioration of most seafood products. Bacterial growth is considered to be the main cause of fish and fish product spoilage. Thus, it is recommended to ap-
ply bacterial count to monitor the quality of food products (Aref et al., 2018).

Sensory evaluation is test or assessment that show the reaction of the consumers towards the food products using their senses. It is a means of determining whether the product is accepted or rejected by the consumers. Boran and Köse., (2007), found an interrelationship between lipid oxidation and sensory deteriorations in ready to eat fish products during frozen storage. Therefore, lipid oxidation should be retarded to prevent or minimize the quality changes and to keep sensory and nutritional values during processing and storage of fish products.

The objectives of this investigation were to:
1-Use the fresh (Nile Karmout) catfish (Claries gariepinus) to produce minced catfish flesh.
2-Adding 1% of Moringa oleifera leaves powder to the minced flesh and produce ready to eat catfish burger product and study its effect on moisture, crude protein, Ash, pH, total acidity, color, water holding capacity (WHC), TBA values, TVB-N values, microbiological quality, and sensory evaluation of catfish burger product.

Materials and Methods:

Materials:
Moringa leaves powder: Moringa plant was gained from the university farm, El-Minia, Egypt. The leaves were completely cleansed, air dried in at ambient temperature for 24 hrs., and mechanically ground to obtain particles of 60 mesh.
Spices blend: Spices (black pepper, cumin powder, thyme powder, onion powder, and garlic powder), salt, and wheat flour were purchased from the local market of Minia city, Egypt.

Methods:

Preparation of cat fish product: Sixty kg of live karmout catfish (Claries gariepinus), average of 57±2 cm in length and 1450±10 g in weight, used in this study is obtained from a local market of El-Minia, Egypt. Fish were iced and transported directly to the Dept. Food Science Laboratory Faculty of Agriculture Minia University. The fish were thoroughly washed, gutted, manually made into fillet and mechanically minced by a meat grinder using 4 mm (coarse). Minced fish was stored refrigerated at 4°C until use.

Catfish burger product was prepared according to the recipe described by Magdy (2010) and shown in (Table 1).

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground catfish Fillet</td>
<td>89.8</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>3.5</td>
</tr>
<tr>
<td>Salt</td>
<td>2.5</td>
</tr>
<tr>
<td>Black pepper powder</td>
<td>1</td>
</tr>
<tr>
<td>Onion powder</td>
<td>1</td>
</tr>
<tr>
<td>Garlic powder</td>
<td>1</td>
</tr>
<tr>
<td>Cumin powder</td>
<td>1</td>
</tr>
<tr>
<td>Thyme powder</td>
<td>0.2</td>
</tr>
</tbody>
</table>

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

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 placed in polystyrene (foam) tray with LDPE
cheats in between to prevent sticking as shown in (Figure 1).

Analytical methods:

**Chemical composition:** Moisture, crude protein, crude fat, and ash, contents were determined according to the methods of the (A.O.A.C, 1995).

**Chemical quality indices:**

**Determination of pH:** pH was measured using digital pH meter according to (Ramadhan et al., 2011). About 10 g of sample was mixed with 90 ml of distilled water using homogenizer and the pH was noted.

**Determination of total acidity:**
The total acidity for fish burger was determined by titration at zero time according to the method described by (Keeton and Melton, 1978). The acidity was expressed as lactic acid.

**Determination of Total volatile basic nitrogen (TVB-N):** The total volatile bases were estimated as described by A.O.A.C (1995). 10g of sample was added to the heating flask containing 300 ml distilled water plus 2 g magnesium oxide. In the receiving flask 25 ml of boric acid (2%) and few drops of methyl red indicator were added. After 25 minutes of distillation, the content of the receiving flask was transferred to another flask and titrated with 0.05N (H2SO4).

The total volatile basic nitrogen (TVB-N) was determined as follows:

\[
\text{(TVB-N)} = \frac{(V \times N \times 100 \times 14)}{W}
\]

Where:
- \(V\) = volume (ml) H2SO4 used for sample.
- \(N\) = normality of H2SO4.
- \(W\) = weight of sample in grams.

**Determination of Thiobarbituric acid (TBA):** The thiobarbituric acid (TBA) was performed as described by Tarladgis et al. (1969).

**Physical analysis:**

**Determination of water holding capacity (W.H.C):** Water holding capacity (W.H.C) was measured according to Alvarez & Tejada. (1992).

While, expressible water is calculated as follow:

\[
\text{Expressible water (\%)} = \frac{\text{PPW} - \text{APW}}{\text{PPW}} \times 100
\]

Where:
- PPW= pre-pressed weight and APW = after-pressed weight

Water holding capacity is calculated as follows:

Water holding capacity (\%) = %Moisture - % Expressible water

**Determination of color (L, a, and b) and whiteness:** Color values (L*, a*, and b*) were measured for fish fillet mince, by a colorimeter (Color Tec PCM Color Meter Tec. NJ. USA). The value L* is a measure of lightness, a*represents the chromatic scale from +a redness to –a greenness and b* represents the chromatic scale from +b yellowness to –b blueness. Three random measurement spots on each sample were made and the average data were recorded (Foh et al., 2011).

**Cooking loss measurement:**

Cooking loss was measured according to the method of Niamnuy et al., (2008) and was calculated from the differences in the mass of minced before and after cooking as follow:

\[
\% \text{Cooking loss} = \frac{(\text{Mass before cooking} - \text{Mass after cooking}) \times 100}{\text{Mass before cooking}}
\]

**Microbiological analysis:**

**Total plate count (TPC):** Total plate count (TPC) was determined as (CFU/g) according to the method of Harrigan and McCance, (1976).
Psychrophilic bacteria: Psychrophilic bacteria was made as (CFU/g) according to the methods described by Collins et al. (1989).

Coliform bacterial count: Coliform bacterial count was determined by the method of (Difco Laboratories Manual, 1998).

Sensory evaluation: Sensory evaluation for color, taste, odor, texture, and overall acceptability for the cooked untreated and treated catfish burger were carried out in order to determine the consumer acceptability for the product according to the methods described by Eyo, (1983). 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 sensory evaluation.

![Flow diagram of production of catfish burger.](image)

**Figure 1.** Flow diagram of production of catfish burger.

**Results and Discussion:**

The effect of adding 1% moringa leaves powder on the chemical composition, pH value and total acidity (lactic acid) of catfish burger is illustrated in Table (2). The data showed that the moisture content decreased as a result of moringa powder due to the low moisture content of dried moringa leaves compared to the catfish flesh, but that addition did not much affected the crude protein, crude either extract, and ash content. The total acidity value (expressed as lactic acid) of the sample contain 1% moringa leaves powder was higher than the control one which reflected on lowering the pH value for the moringa powder containing sample. The results come in agreement which found by (Mahmoudzadah et al., 2010), and Zhu et al., 2015).
Table 2. Effect of adding 1% moringa leaves powder on the chemical composition of catfish burger % (wet weight basis).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>1% moringa powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>69.01±0.15</td>
<td>67.67±0.57</td>
</tr>
<tr>
<td>Crude protein (N x 6.26)</td>
<td>17.85±0.23</td>
<td>17.22±0.59</td>
</tr>
<tr>
<td>Crude either extract</td>
<td>4.64±0.11</td>
<td>4.42±0.19</td>
</tr>
<tr>
<td>Ash content</td>
<td>4.03±0.10</td>
<td>4.01±0.07</td>
</tr>
<tr>
<td>pH</td>
<td>6.31±0.01</td>
<td>6.26±0.01</td>
</tr>
<tr>
<td>Total acidity (lactic acid)</td>
<td>0.66±0.01</td>
<td>0.72±0.05</td>
</tr>
</tbody>
</table>

Means of 3 replicates ±SD

Dimethylamine (DMA), trimethylamine (TMA), and ammonia (NH3) are three compounds that known as the total volatile basic nitrogen compounds (TVB-N) or as volatile amines. After the death of fish the activity of spoilage bacteria increased, resulting in reduction of trimethylamine oxide to trimethylamine (TMA), dimethylamine (DMA) and other compounds as subsequent of that action. The effect of adding 1% moringa leaves powder on the total volatile basic nitrogen (TVB-N), thiobarbituric acid (TBA), and color values (L*, a*, b*) of catfish burger are illustrate in Table (3).

The data showed a reduction in both (TVB-N), and (TBA) values for the sample contained 1% moringa leaves powder. That means the addition of moringa powder little reduced the (TVB-N) and (TBA) values and suppressed the formation of the total volatile basic nitrogen (TVB-N) because moringa leaves have been described to be an excellent source of natural antioxidants as mentioned by (Al-Juhaimi et al., 2015). The data also revealed reduction in the L* and b* values and an increase in a* value due to the addition of 1% moringa leaves powder (Avile’s, et al., 2014).

Table 3. Effect of adding 1% moringa leaves powder on the (TVB-N), (TBA), and color values (L*, a*, b*) of catfish burger % (wet weight basis).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>1% moringa powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVB-N (mg/100g)</td>
<td>9.14±0.56</td>
<td>8.91±0.39</td>
</tr>
<tr>
<td>TBA(mg malonaldehyde/kg)</td>
<td>1.17±0.01</td>
<td>1.03±0.01</td>
</tr>
<tr>
<td>L*</td>
<td>41.83±0.46</td>
<td>37.27±0.66</td>
</tr>
<tr>
<td>a*</td>
<td>13.19±0.14</td>
<td>17.30±0.29</td>
</tr>
<tr>
<td>b*</td>
<td>22.50±0.13</td>
<td>18.55±0.37</td>
</tr>
</tbody>
</table>

Means of 3 replicates ±SD

Figure (2) illustrated the effect of adding 1% moringa leaves powder on water holding capacity (WHC), expressible water (EW), and cooking loss of catfish burger. The data showed a reduction in the water holding capacity value and an increase in both expressible water and the cooking loss due to the addition of 1% moringa leaves powder. The low cooking loss for the control sample reflected the high WHC value which means the high power to capture the water in the protein matrix.
Figure 2. Effect of adding 1% moringa leaves powder on water holding capacity (WHC), expressible water (EW), and cooking loss of catfish burger.

Figure 3. Effect of adding 1% moringa leaves powder on the total count, the psychrophilic bacterial count, and E.coli of catfish burger (log CFU/g).

The microbiological safety and quality of fish and fish products are very important to processors, retailers, and of course consumers. Due to its nature, fish is generally susceptible to contaminate with pathogens and other microorganisms. The effect of adding 1% moringa leaves powder on the total count, the psychrophilic bacterial count, and E.coli of catfish burger (log CFU/g) is shown in Figure (3). The data showed that the addition of 1% moringa leaves powder to the catfish burger reduced all the examined bacterial counts (total, psychrophilic, and E.coli) due to the antimicrobial effect of moringa leaves powder. That means the addition of moringa powder to the formula negatively affected the surviving of the microorganisms that contaminating the catfish burger. The results come in agreement with (Zhu et al., 2015).

Quality of fish products are generally examined by sensory evaluation. The effect of adding 1%
moringa leaves powder on the sensory evaluation (color, taste, odor, texture, and general acceptability) of catfish burger is illustrated in figure (4). The data showed that the addition of 1% moringa leaves powder to the catfish formula had increased the values for color, taste, odor, texture, and general acceptability compared to the control one.

![Figure 4](image)

**Figure 4.** Effect of adding 1% moringa leaves powder on the sensory evaluation of catfish burger.

**References:**


تأثير إضافة مطحون أوراق المورينجا على التقييم الكيميائي والميكروبي والحسوي لبرجر سمك القرموم الطليعي (Claries gariepinus) في مصر

رانيا حسن عبد الطيف، محمد أحمد قناؤى وحسن عبد الجليل عبد العال

قسم علوم الأغذية - كلية الزراعة - جامعة المنية

الملخص

تعتبر الأسماك من أرخص مصادر البروتين الحيواني في جميع أنحاء العالم. حيث توفر البروتين والفيتامينات والمعادن وأحماض أوميجا 3 في الوجبات الغذائية للأنسان خاصة في الدول الفقيرة. كما يمثل الانتاج السمكي أحد مصادر الدخل القومي المصري، وقد أعلنت هيئة الثروة السمكية المصرية في عام 2020 أن الإنتاج السمكي قد بلغ مليون 960 ألف طن. ويعتبر القرموم الطليعي هو أحد أنواع الأسماك المستثكرة في مصر، لذلك فقد أجريت هذه الدراسة لاستخدام سمك السلمون الطليعي (Claries gariepinus) في إنتاج برج السماك. تم دراسة تأثير إضافة 1% من مسحوق أوراق المورينجا على خلطة البرجر، ودراسة تأثير تلك الإضافة على كل من التركيب الكيميائي، والنشاط الميكروبيولوجي والتقييم الحسي للمنتج. وقد أظهرت البيانات أن إضافة 1% من مسحوق أوراق المورينجا إلى برج سمك السلمون قد تسبب في تقليل قدرة الاحتفاظ بالماء، وزيادة الفاقد في الطهي، بينما قلل من العد البكتيري وأدى إلى تحسين التقييم الحسي مقارنة بعينات الكونترول.