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Quality Characteristics of Common Carp Fish Patties Incorporated with some Plant Extracts During Frozen Storage

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ABSTRACT

This study aims to evaluate the changes in chemical composition, physicochemical, microbiological and sensory quality of fish patties incorporated with some plant extracts (green tea, rosemary and black seed) during storage at -18˚C. The results revealed that, common carp patties contained 65.25-65.89% moisture, 22.50-22.90% protein, 5.72-5.89 lipid, 5.20-5.23% ash. Cooking loss and yield of carp fish patties were ranged from 15.20 to 15.50 % and 82.90-84.89%, respectively. Total volatile basic nitrogen, trimethylamine and thiobarbituric acid values were significantly ($P<0.05$) increased throughout storage in control samples and reached 28.39 (mg/100g), 3.60 (mg/100 g) and 1.30 mg MDA/kg after 120 days of frozen storage, respectively. On the other hand, there was also a significant increase in these values in all treatments during frozen storage, but it was less than the control samples. These amounts didn't exceeded the maximum permissible limits reported by national and international standard organizations. Based on this results, it can be deduced that the incorporated plant extracts successfully improve physicochemical, microbiological and sensorial qualities of the common carp fish patties during frozen storage. The green tea treatment was the best, followed by black seed and rosemary.

Keywords: Fish patties, quality, frozen storage, plant extracts.

INTRODUCTION

Fish patties is a value-added product that have increased in demand in lastl years (Sehgal and Sehgal, 2002). Quality deterioration, waste of nutritional quality and lessening of shelf life due to autoxidation and rancidity processes of frozen fish patties is the main important problems in this technology (Yerlikaya and Gokoglu, 2010). Therefore, synthetic antioxidants have been used for a long time for preserving fish products, but it was found that, they have toxic and carcinogenic effects on human health during long-term (Lourenço, *et al*., 2019). Recently researchers focusing on using natural antioxidants as safe natural products for human health and also desirable for the Egyptian consumer (Talab, 2014).

Many researchers have conducted many studies to develop the physicochemical, sensory qualities and to extent the shelf-life of fish patties, for example, Destura and Haard (1999) used potassium sorbate and TBHQ during processing rockfish patties, while, Tang, *et al*., (2001) used 300 mg/kg of tea catechins to reduce the oxidation of mackerel patties. A chitosan and a gelatin solution was used to cod fish patties (Lo´pez-Caballero, *et al*., 2005). Sehgal, *et al*., (2008) used boiled potato and corn flour as extenders during processing *Labeo rohita* fish patties. Giménez, *et al*., (2011) evaluated the horse mackerel patties covered with gelatin-based films containing a borage seed extract during frozen storage. Valizadeh, *et al*., (2020) extended the shelf life of rainbow trout fish patties using biopolymer-coated active paper sheets. The effect of acrolein on the formation of the 2-amino-1-methyl-6-phenylimidazo [4,5-b] pyridine (PhIP) of roasted tilapia were studied by Jing, *et al*., (2022a) and salmon fish patties by Jiang, *et al*., (2022b). Xu, *et al*., (2022) used pectin, alginic acid, CMC-Na, and chitosan to reduce the formation of thermally induced toxicants in fish patties.

Therefore, the objective of this research was to improve fish patties using some natural plant extracts (green tea, rosemary and black seed) and to evaluate the nutritional composition, physicochemical, microbiological, organoleptic quality aspects and oxidative stability during storage at -18˚C.

MATERIALS AND METHODS

Fish samples:

50 kg of fresh common carp fish (*Cyprinus carpio*) samples with rate weight and length of (3.95 kg and 55.15 cm) were purchased from El-Obor city fish market during April 2019 and immediately brought into Fish Processing and Technology Laboratory, El-Kanater El-Khairia, National Institute of Oceanography and Fisheries within 2 hours using iceboxes. Upon arrival, fish samples were washed, cleaned, beheaded, descaled, gutted, washed carefully again to remove slime and blood, and then filleted. Common carp fish fillets were minced using a 3 mm diameter holes plate kitchen meat mincer.

Ingredients and chemicals:

Spices, sugar, starch, salt and edible oils were purchased from Ragab Sons market, Cairo, Egypt. All chemicals (sodium bicarbonate, sodium polyphosphate) applied in this research were of analytical grade and were purchased from El-Gomhoria Company for drugs and medical supplies. All other ingredients onion, garlic has been brought from local market and were of food grade quality. Plant extracts (green tea, rosemary and black seed) were procured from reputed commercial suppliers.

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Fish patties production:

Fish patties were processed according to the formula reported by Chandrasekhar and Mohite (1978) using 70% minced carp meat, 2.3% salt, 1% sugar , 8% starch, 7% palm oil, 6% ice water, 2% onion powder, 0.5% garlic powder, 0.4% sodium bicarbonate, 0.3% sodium polyphosphate, 0.5% antioxidant, 2% spices mixture (23% cumin, 42% black pepper,18% fish spices, 5% cardamom, 5% ginger, 2% cloves, 2% cubeb, 2% coriander and 1% red pepper). The ingredients were homogenized with minced carp by kitchen machine blender. Four batches of carp fish patties were produced: T0: control (without any plant extracts); T1: with 0.5% green tea extract; T2: with 0.5% rosemary extract and T3: with 0.5% black seed extract. A-50 ml of water extracts of green tea, rosemary and black seed was individually added to minced fish samples in order to obtain a final concentration of 100 mg equivalent phenolics per kg of meat. After the addition of antioxidant sources, each group was thoroughly mixed and formed into patties. Fish patties samples were packed and stored at -18°C for 120 days and the analysis were done every month. Fish patties samples were left for 4 min and then deep-fried in sunflower oil preheated at 160°C for 5-6 min.

Analytical methods:

Moisture, protein, fat, ash content and trimethylamine nitrogen (TMA-N) were analyzed as (AOAC, 2002). Cooking yield, by El-Magoli, *et al*., (1996), while cooking loss was calculated as Jama, *et al*., (2008). Total volatile basic nitrogen (TVB-N), thiobarbituic acid (TBA) and the pH value (Pearson, 1991) were analyzed. In addition, microbial load was considered, and the total plate count (TPC) using plate count agar (FAO, 1992) was examined. Sensory tests (Fey & Regenstein, 1982) were evaluated. The results obtained (Microsoft Office Excel, 2010) were statistically analyzed and they (n=3) were expressed as Mean±SD.

RESULTS AND DISCUSSION

Chemical composition of fish patties:

The changes in the proximate structure of fish is may be due to harvesting season, feeding , sexual and seasonal variations, living area, fish size beside that environmental factors (Gandotra *et al*., 2012). The measurements of chemical composition of fish patties was conducted for 120 days of frozen storage and is displayed in Fig. (1).

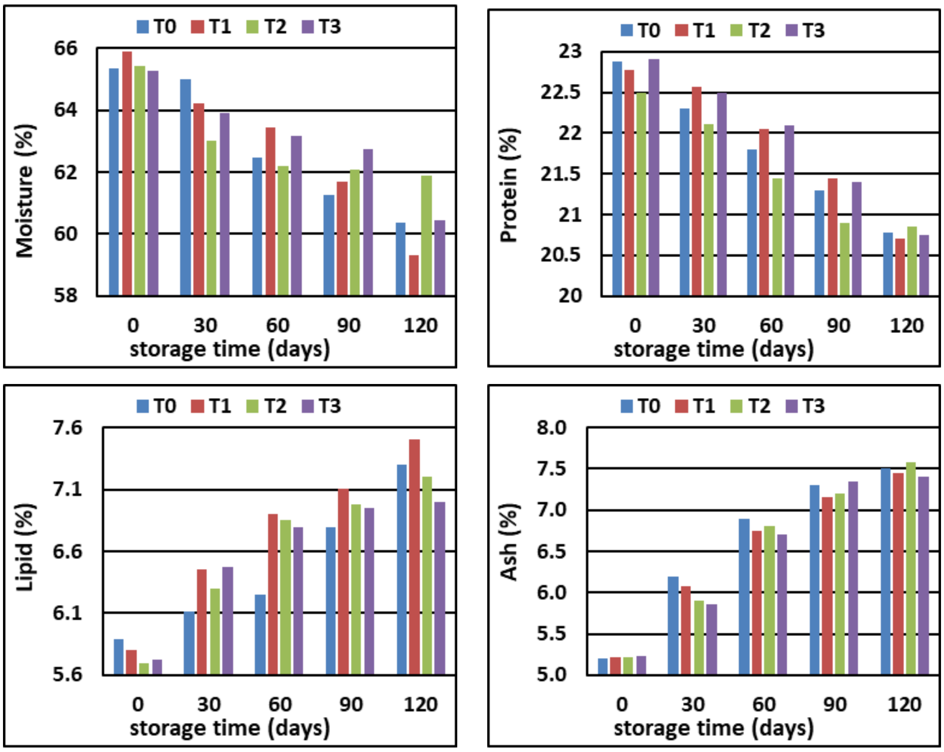

Fig. 1. Effect of frozen storage for 120 days on chemical composition of studied fish patties samples.

During frozen storage, the moisture content was significantly decreased from 65.33% to 60.35, 65.89% to 59.30, 65.44% to 61.89 and 65.25% to 60.44% in T0, T1, T2 and T3, respectively. While protein content was significantly decreased from 22.87% to 20.78%, 22.78% to 20.70%, 22.50% to 20.85% and 22.90% to 20.75% in T0, T1, T2 and T3, respectively. Also, lipid contents of T0, T1, T2 and T3 of frozen fish patties were significantly increased from 5.89% to 7.30%, 5.80% to 7.50%, 5.70% to 7.20% and 5.72% to 7.00%, respectively. On the same way ash content was significantly increased from 5.20% to 7.50%, 5.22% to 7.45%, 5.21% to 7.58% and 5.23% to 7.40% in T0, T1, T2 and T3, respectively (Fig. 1).

The decrease in the moisture content of the fish patties may be due to the effect of different thermal processing treatments on water loss or due to drip processes that occur during the defrosting of different frozen fish products (Roomiani, *et al*., 2019) or may be due to the loss of water holding capacity of tissue (Zamir, *et al*., 1998). Also the reduction of the protein content of fish patties during frozen storage may be attributed to water dripping which led to leach out some soluble nitrogenous compounds during different storage temperatures (Haq, *et al*., 2013, Bavitha, *et al*., 2016) or may be attributed to protein hydrolysis by enzymes or the loss of water soluble nitrogen with separated isolated as affected by the loss of some volatile nitrogenous compounds during frozen storage (Abo-Taleb, 1997). Gandotra *et al.*, (2012) indicated that, amino acid and water-soluble protein may be thawed during frozen storage. The rise in fat can be attributed to the reduction in moisture content as they are inversely relative (Abou-Taleb, *et al.*, 2022). The increase in the concentration of ash during storage at freezing temperatures can be attributed to the reduction of the values of protein and fat in fish products (Gomma, *et al.*, 2019).

Cooking characteristics of fish patties

The cooking loss and cooking yield of carp fish patties samples T0, T1, T2 and T3 at zero time were (15.20, 15.50, 15.33 and 15.40%) and (82.90, 83.15, 85.18 and 84.89%), respectively. Significant increases in cooking loss and cooking yield were noticed in carp fish patties formulated with different plant extracted compared with control. The highest increase in cooking loss was noticed for green tea trail (15.50%), while rosemary extract trail showed the highest values (85.18%) of cooking yield. Our results were in line with previous investigations by (Abou-Taleb and Abdel-Razik, 2005).

Physicochemical characteristics of fish patties:

Physicochemical characteristics of fish patties stored at -18°C for 120 days are shown in Fig. (2). The results revealed that, pH value of fish patties decreased from 6.50 to 5.40, 6.40 to 5.35, 6.45 to 5.45 and 6.39 to 5.50 in T0, T1, T2 and T3, respectively. Also, the added plant extracts did not significantly affect on pH values of carp fish patties at zero time but pH values were significantly affected (p>0.05) throughout frozen storage. The reduction in pH values of carp fish patties during frozen storage may be due to fermentation of carbohydrate source in patties recipe (Bavitha, *et al.*, 2016). Furthermore, Mokhtar, *et al.*, (2012) specified that increment in pH value be due to the breakdown of ammonia compounds as a result of proteolytic microbial flora present in the raw meat.

Whereas, TVBN value of fish patties at zero time of T0, T1, T2 and T3, were 16.80, 16.60, 16.71 and 16.30 (mg/100g), respectively, while it reached at the end of frozen storage (120 days) to 28.39, 24.80, 23.90 and 25.30 (mg/100g), respectively (Fig. 2). On the other hand TMA contents of fish patties ranged from (0.85-3.60 mg/100g) for T0; (0.80-3.30 mg/100g) for T1; (0.82-2.89 mg/100g) for T2 and (2.40-3.20 mg/100g) for T3. While, TBA values of fish patties ranged from (0.15-1.30 mg MDA/kg) for T0; (0.11-1.28 mg MDA/kg) for T1; (0.10-0.20 mg MDA/kg) for T2 and (0.12-1.25 mg MDA/kg) for T3 (Fig. 2).

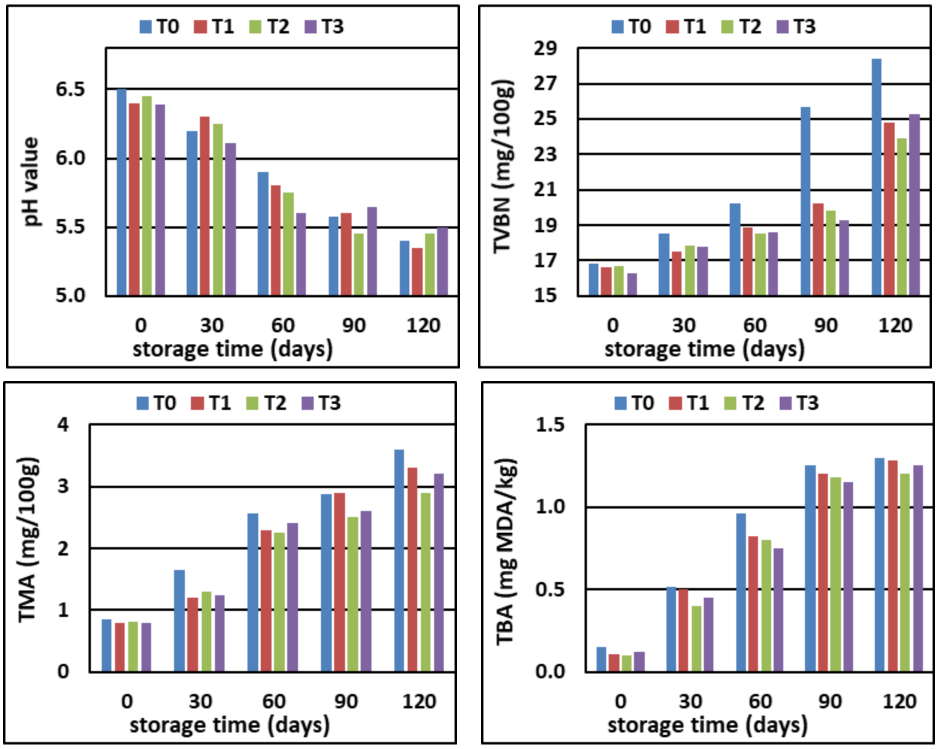

Fig. 2. Effect of frozen storage for 120 days on physicochemical characteristics of studied fish patties samples.

It could be noticed that, there were a significant differences (p>0.05) between the four groups where studied plant extracts slow down the increase of the TVBN, TMA and TBA values in comparison of the control group during frozen storage. Therefore, green tea, rosemary and black seed could be effective natural preservative and antioxidants for use in controlling lipid oxidation in fish patties. The increase of TVBN of fish patties throughout frozen storage may be due to the production of ammonia (Adebona, 1978).

TVBN is known as an indicator of bacterial and enzyme activities, it considered the main quality standard aspect as indication of the shelf- life of seafood (EEC, 1995). Chomnawang, *et al.*, (2007) stated that protein autolysis as a result of bacterial and enzymatic activity caused an increment in TVBN during different storage conditions. TBA is an quality index of rancidity as a secondary breakdown product of lipid oxidation (Aubourg, 1999). The increase in thiobarbituric acid values during different storage conditions could be attributed to the evolution of lipid rancidity in seafood.

Microbiological characteristics of studied fish patties

Total bacterial count of studied fish patties at zero time of T0, T1, T2 and T3 recorded 3.90, 3.75, 3.80 and 3.70 (log cfu/g), respectively, while it reached at the end of frozen storage (120 days) to 2.80, 2.82, 2.85 and 2.74 (log cfu/g), respectively (Fig. 3).

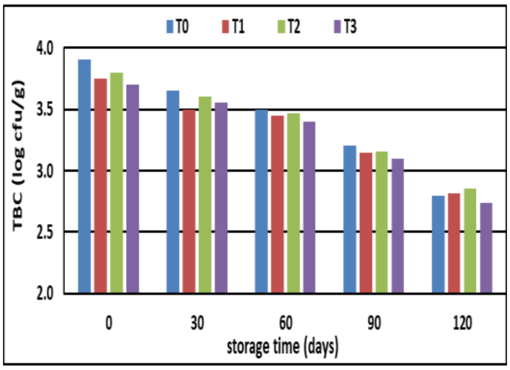

Fig. 3. Effect of frozen storage for 120 days on total bacterial count of studied fish patties samples.

Microbiological quality of fish patties stored with-18°C for 120 days.With regard the effect of plant extracts and freezing storage periods up to 120 days on microbial load, counts of TPC markedly decreased in all trails compared with zero time. Like consideration has been made for the patties prepared from different weight groups of rout (Sehgal, *et al*., 2008). The total bacterial counts above the logarithm of 7 cfu/g are usually considered unsuitable for human consumption (Ulrike, *et al.*, 2000).

Organoleptic quality aspects of fish patties

Sensory evaluation of studied fried common carp fish patties containing different plant extracts are shown in (Fig. 4). The results showed that, there was respectable (p>0.05) differences of such added plant extracts on sensorial goodness of fried fish patties because they gave higher ratings in comparison with control group. Identical results were mentioned by Sehgal, *et al.*, (2011) and Talab (2014).

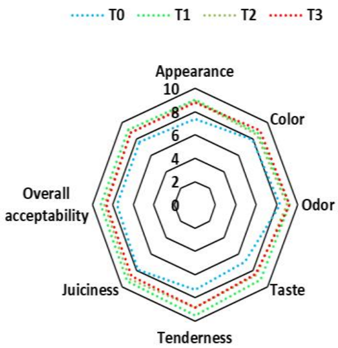

Fig. 4. Sensory quality of studied common carp fish patties at zero time.

CONCLUSION

According to the physicochemical, microbiological and sensorial quality results, which indicated that, the highest levels of TVB-N, TMA and TBARS were related to the control group and the amount didn't exceeded the maximum permissible limits reported by national and international organizations. Based on this data, it could be deduced that the natural plant extracts successfully improve physicochemical, microbiological and sensorial quality of common carp fish patties during frozen storage for 120 days.

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خصائص جودة باتيه أسماك المبروك المدعم ببعض المستخلصات النباتية أثناء التخزين بالتجميد

عبدالرحمن سعيد تعلب ، مها إسماعيل جنينة، فيفى راغب أنيس و نادية صابر أحمد
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الملخص

تهدف هذه الدراسة إلى تقييم التغيرات في التركيب الكيميائي وخصائص الجودة الفيزيائية والكيميائية والميكروبيولوجية والحسية للباتيه السمكى المدعم ببعض المستخلصات النباتية (الشاي الأخضر والروزمارى وحبة البركة) أثناء التخزين عند ‎-١٨‎ درجة مئوية لمدة ١٢٠ يوم. أظهرت النتائج احتواء باتيه أسماك المبروك العادى على ٦٥,٢٥-٦٥,٨٩٪ رطوبة ، ٢٢,٥٠-٢٢,٩٠٪ بروتين ، ٥,٧٢-٥,٨٩٪ دهون ، ٥,٢٠-٥,٢٣٪ رماد. تراوحت قيم فاقد الطهى وريع الطهى لباتيه أسماك المبروك العادى (١٥,٢٠-١٥,٥٠٪) و (٨٢,٩٠-٨٤,٨٩٪) على التوالي. هذا وقد حدثت زيادة معنوية فى قيم النيتروجين الكلى المتطاير وثلاثى ميثيل أمين وحامض الثيوباربيتوريك خلال التخزين بالتجميد في عينات الكنترول وبلغت ٢٨,٣٩ (مجم / ١٠٠ جم) و ٣,٦٠ (مجم / ١٠٠ جم) و ١,٣٠ مجم مالونالدهيد / كجم في نهاية ١٢٠ أيام التخزين المجمد ، على التوالي. من ناحية أخرى ، كانت هناك أيضًا زيادة معنوية في هذه القيم في جميع المعاملات أثناء التخزين المجمد ، ولكنها كانت أقل من العينات الكنترول. ولكن لم تتجاوز الحدود القصوى المسموح بها فى المواصفات القياسية المحلية والدولية. بناءً على هذه النتائج، يمكن استنتاج أن تدعيم باتيه أسماك المبروك العادى ببعض المستخلصات النباتية نجحت في تحسين الصفات الفيزيائية والكيميائية والميكروبيولوجية والحسية أثناء التخزين بالتجميد. وكانت معاملة الشاى الأخضر هى أفضل المعاملات يليها حبة البركة ثم الروزمارى.