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

Talab, A. S.*; Maha E. Genina; Fify R. Anees and Nadia A. Saber
National Institute of Oceanography and Fisheries (NIOF), Egypt

INTRODUCTION

Fish patties is a value-added product that have increased in demand in last 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 (Loureño, 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-Khâria, 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.

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

* Corresponding author.
E-mail address: Abdelrahman_saidh@yahoo.com
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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 may be due to harvesting season, feeding, sexual and seasonal variations, living area, fish size besides 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 extracts 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).

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).


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 exceed 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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