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Effect of some plant extracts on the quality of fish sausage and burger

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ABSTRACT

The objective of this study was to evaluate the effectiveness of some commercial plant extracts 0.5% (grape, green tea, orange and rosemary), (black seed, jojoba, chamomile and parsley) on the proximate compositions, physicochemical and sensory properties of the Nile tilapia fish sausage and burger stored at -18°C for three months. The results indicated that, the proximate compositions, physicochemical and sensory properties of processed fish products differed among samples of plant extracts used in the preparation of the samples. On the other hand, color, flavor, taste, tenderness, juiciness and overall acceptability were significantly decreased during the frozen storage period of both sausage and burger. Meanwhile, a significant increase was recorded in the values of ash, pH, TVBN, TMA and TBA during the same period. The values of sensory score were better compared to the control; nevertheless, no significant differences were detected among the additives in fish sausage. While, fish sausage with orange and grape were better than green tea and rosemary extracts in flavor and tenderness. On the other hand, the values of flavor, taste, tenderness, juiciness and overall acceptability were determined for fish burger treated with jojoba and chamomile plant extracts.

INTRODUCTION

Plant extracts are used as an antimicrobial agent in fresh and processed seafood and their packaging as extracts, stems, leaves and roots. Several plant compounds commonly used as natural agents {Essential oils (EOs)} for food preservation exert different biological properties and enjoy the "generally recognized as safe" (GRAS) status conferred by the US Foods and Drugs Administration **(Rodrigues, *et al.*, 2017)**. Antioxidants play an important and effective role in protecting our bodies from dangerous diseases, and the whole world, especially in the food industry, is now turning to the use and addition of natural antioxidants compounds because of their therapeutic, agricultural and industrial importance. Moreover, it plays an effective role against electrolytes that may cause malignancies that are spreading in a frightening way in

societies nowadays. Recently, great attention has mainly been drawnby "green consumers" to the application of essential oils as natural antimicrobial products for being an alternative of chemical synthesis to common food preservatives. Furthermore, the emergence of pathogens resistant to classical preservatives has determined an urgent necessity for alternative antimicrobial agents **(Settanni, *et al*., 2012; Boroumand, *et al*., 2021)**. Many plant extracts have been used as natural antioxidants during seafood processing. In addition, many studies on replacement of synthetic antioxidants with natural antioxidant sources have been performed for producing semi processed fishery products **(Oswell, *et al.*, 2018)**. Therefore, the current study was designed to determine the antioxidant efficacy of some plant extracts in protecting the fresh Nile tilapia sausage and burger against lipid oxidation and quality deterioration during frozen storage.

MATERIALS AND METHODS

Fish samples

An amount of sixty kg of the Nile tilapia (*Oreochromis niloticus*) was collected from Lake Nasser during December 2020. Samples were immediately transported using an ice box within 12 hours to the Fish Processing and Technology Laboratory, El-Kanater El-Khairia, Fish Research Station, National Institute of Oceanography and Fisheries. The mean total lengths and weights of the collected fish samples were calculated, recording values of 65cm and 6.29kg, respectively. Fish samples were carefully washed with tap water, beheaded, gutted, filleted, rewashed carefully and drained.

Plant extracts and other ingredients

Plant extracts (grape, green tea, orange and rosemary), (black seed, jojoba, chamomile and parsley) were procured from reputed commercial suppliers. All other ingredients (salt, sugar, starch, palm oil, onion, garlic, sodium bicarbonate, sodium polyphosphate, antioxidant, spices mixture) were purchased from the local market and were of food grade quality.

Fish sausage and burger production

The fish sausage and burger processed from the Nile tilapia fish samples was achieved following the modified method of **Al-Bulushi *et al.* (2005)**. Fish sausage was processed using 69% minced tilapia, 1.8% salt, 1% sugar , 8% starch, 8% palm oil, 6% ice water, 2.5% 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 the minced tilapia using Varimix kitchen machine blender. While in the fish burger, 75% of minced fish meat was used and no ice water was added. Fish sausage was emulsified in the cutter with the other ingredients for 5 min. Emulsions were then filled (manual sausage filler) into 25-mm natural sheep casing, hand tied and left to an aging process in room temprature. Five treatments of fish sausage were produced as follows: control, grape, green tea, orange and

rosemary. While, five treatments of fish burger were produced as follows: control, black seed, jojoba, chamomile and parsley.

Analytical methods

Moisture content was determined using the oven-drying method. Protein content was quantified by the Kjeldahl method. Fat content was determined using the Sohxlet method according to **AOAC (2002)**. Total volatile basic nitrogen (TVB-N) content was determined following the method of **Pearson (1976)**. Trimethylamine content was determined according to **AMC (1979)**. While, the thiobarbituric acid (TBA) value was measured stepping the method described in the study of **Tarladgis *et al.* (1960)**. The sensory evaluation of color intensity of goosemeat was carried out by a trained sensory panel of 7people according to the international standard **(ISO, 1988)**. The statistical analysis of the data was performed using one-way analysis of variance (ANOVA) as reported in the study of **Snedecor and Cochran (1980)**.

RESULTS AND DISCUSSION

Chemical composition of Nile tilapia fish sausage and burger

Effect of different plant extracts on the chemical composition (%, on wet weight basis) of the Nile tilapia fish sausage during frozen storage (-18°C) for 120 days is shown in Table (1). The moisture, protein, lipids and ash values of control, grape, green tea, orange and rosemary of the Nile tilapia sausage at zero time were (59.55, 59.35, 59.50, 59.58, 59.44%); (17.01, 17.25, 17.11, 17.31, 17.30%); (13.59, 13.05, 13.62, 13.43, 13.55%) and (3.43, 3.97, 3.55, 3.22, 3.60%), respectively. They were changed after 60 days of frozen storage to record (57.86, 57.74, 57.30, 57.98, 57.68%; 16.38, 16.25, 16.11, 16.75, 16.80%); (13.25, 13.00, 13.30, 13.10, 13.22%) and (5.90, 5.87, 5.45, 5.35, 5.98%), respectively. While after 120 days of frozen storage at -18°C, they reached records of (55.30, 55.25, 55.68, 55.78, 55.45%); (15.35, 15.20, 15.44, 15.98, 15.30%); (12.48, 12.65, 11.89, 11.78, 11.33%) and (7.54, 7.55, 7.98, 7.50, 7.33%), respectively.

On the other hand, Table (2) exhibits the moisture, protein, lipid and ash values of the control, black seed, jojoba, chamomile and parsley of the Nile tilapia fish burger at zero time. Values recorded were (68.85, 68.95, 68.45, 68.78, 68.31%); (20.37, 20.01, 20.58, 20.64, 20.48%); (8.11, 7.89, 8.01, 8.13, 8.11%) and (2.45, 2.90, 2.85, 2.22, 2.89%), respectively. Values determined were changed after 60 days of frozen storage recording (65.89, 65.48, 65.30, 65.15, 65.78%); (18.67, 18.56, 18.98, 18.34, 18.28%); (7.48, 7.19, 7.56, 7.48, 7.47%) and (4.77, 4.98, 4.78, 4.23, 4.87%), respectively. While after 120 days of frozen storage at -18°C, values reached records of (63.80, 63.75, 63.60, 63.50, 63.45%); (16.30, 16.87, 16.45, 16.98, 16.11%); (6.85, 6.55, 6.33, 6.17, 6.68%) and (7.35, 7.55, 7.65, 7.89, 7.38 %), respectively.

Table 1. Effect of different plant extracts on chemical composition (%, on wet weight basis) of Nile tilapia fish sausage during frozen storage at -18°C for 120 days

Trial & storage time	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
Zero time				
Control	59.55±0.65	17.01±0.75	13.59±0.36	3.43±0.47
Grape	59.35±0.79	17.25±0.65	13.05±0.48	3.97±0.65
Green tea	59.50±0.69	17.11±0.60	13.62±0.55	3.55±0.58
Orange	59.58±0.80	17.31±0.79	13.43±0.52	3.22±0.45
Rosemary	59.44±0.90	17.30±0.64	13.55±0.44	3.60±0.48
After 60 days				
Control	57.86±0.25	16.38±0.51	13.25±0.41	5.90±0.43
Grape	57.74±0.97	16.25±0.56	13.00±0.35	5.87±0.45
Green tea	57.30±0.30	16.11±0.47	13.30±0.41	5.45±0.75
Orange	57.98±0.45	16.75±0.60	13.10±0.40	5.35±0.87
Rosemary	57.68±0.47	16.80±0.53	13.22±0.43	5.98±0.55
After 120 days				
Control	55.30±0.40	15.35±0.89	12.84±0.47	7.54±0.48
Grape	55.25±0.46	15.20±0.68	12.65±0.50	7.55±0.41
Green tea	55.68±0.45	15.44±0.47	11.89±0.52	7.98±0.52
Orange	55.78±0.51	15.98±0.86	11.78±0.51	7.50±0.48
Rosemary	55.45±0.47	15.30±0.75	11.33±0.42	7.33±0.47

Data are calculated as mean ± (SD) Standard deviation; n=3.

Table 2. Effect of different plant extracts on chemical composition (%, on wet weight basis) of Nile tilapia fish burger during frozen storage at -18°C for 120 days

Trial & storage time	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
Zero time				
Control	68.85±0.03	20.37±0.33	8.11±0.18	2.45±0.12
Black seed	68.95±0.04	20.01±0.35	7.89±0.17	2.90±0.13
Jojoba	68.45±0.02	20.58±0.37	8.01±0.13	2.85±0.12
Chamomile	68.78±0.01	20.64±0.35	8.13±0.19	2.22±0.18
Parsley	68.31±0.04	20.48±0.34	8.11±0.11	2.89±0.10
After 60 days				
Control	65.89±0.25	18.67±0.15	7.48±0.28	4.77±0.48
Black seed	65.48±0.27	18.56±0.18	7.19±0.98	4.98±0.11
Jojoba	65.30±0.11	18.98±0.28	7.56±0.45	4.78±0.15
Chamomile	65.15±0.65	18.34±0.70	7.48±0.65	4.23±0.45
Parsley	65.78±0.28	18.28±0.45	7.47±0.48	4.87±0.78
After 120 days				
Control	63.80±0.28	16.30±0.28	6.85±0.28	7.35±0.58
Black seed	63.75±0.24	16.87±0.35	6.55±0.49	7.55±0.28
Jojoba	63.60±0.65	16.45±0.45	6.33±0.48	7.65±0.27
Chamomile	63.50±0.45	16.98±0.78	6.17±0.29	7.89±0.19
Parsley	63.45±0.12	16.11±0.45	6.68±0.89	7.38±0.26

Data are calculated as mean ± (SD) Standard deviation; n=3.

Results revealed no significant difference between the added plant extracts in fish sausage and burger at zero time. While, values of moisture, protein and lipid were significantly decreased during the frozen storage period. Meanwhile, the values of ash were significantly increased during the same period. Some authors attributed the decrease in moisture content to the loss of drip during thawing process as a result of the sublimation of ice during frozen storage. On the other hand, some researchers found an increase in the moisture content during frozen storage and attributed this increase to the loss of water holding capacity of the tissue **(Vanitha *et al*., 2016; El-Lahamy *et al*., 2019; Gomma *et al*., 2019; Roomiani *et al*., 2019)**. This increase in ash content is attributed to the reduction of the moisture content, since it presents an inverse correlation of the lipids content. Likewise, since the proximal composition are lost (such as protein), the fat content, in relation to the total (100%), witnessed an increase **(Ordóñez *et al*., 2005)**. The decrease in protein content during the frozen storage of fish products may be due to the leaching effect on the amino acid and the water-soluble protein during thawing process. Whereas, the loss of some volatile nitrogenous compounds during frozen storage and the protein hydrolysis by enzymes enhanced the loss of water soluble nitrogen with separated drip **(Gandotra *et al*., 2012; El-Lahamy *et al*., 2019; Gomma *et al*., 2019)**. The decrease in fat content might be related to the oxidation and hydrolysis of lipids, resulting in the formation of some volatile compounds as aldehydes and ketones. Similar results were reported in previous studies **(Gandotra *et al*., 2012; Ibrahim & El-Sherif 2008; El-Lahamy *et al*., 2019)**. Notably, the increase in ash contents of fish sausage and burger during the frozen storage might be due to the loss in protein and fat contents **(Gomma *et al*., 2019)**.

Physicochemical properties of Nile tilapia fish sausage and burger

Table (3) shows the effect of different essential oils on physicochemical properties (%, on wet weight basis) of the Nile tilapia fish sausage during frozen storage at -18°C for 120 days. The results indicated that, the pH value, TVBN (mg/100g), TMA (mg/100g), TBA (mg MDA/kg) of the control, grape, green tea, orange and rosemary of the Nile tilapia fish sausage at zero time were 8.28, 8.06, 8.00, 7.99, 7.84; 19.89, 14.22, 14.99, 14.73, 14.27 (mg/100g); 7.90, 6.17, 6.70, 5.14, 6.73 (mg/100g) and 0.341, 0.333, 0.312, 0.253, 0.278 (mg MDA/kg), respectively. Values were changed after 60 days of frozen storage, recording 8.33, 8.11, 8.05, 8.08, 7.90; 20.01, 14.30, 15.18, 14.90, 14.47 (mg/100g); 7.92, 6.25, 6.73, 5.33, 6.80 (mg/100g) and 0.344, 0.337, 0.324, 0.270, 0.283 (mg MDA/kg), respectively. While, these values reached records of 8.37, 8.14, 8.09, 8.17, 8.04; 20.12, 14.38, 15.37, 15.08, 14.66 (mg/100g); 8.01, 6.33, 6.81, 5.57, 6.96 (mg/100g) and 0.347, 0.340, 0.336, 0.286, 0.288 (mg MDA/kg), respectively at the end of the frozen storage at -18°C.

Table 3. Effect of different plant extracts on physicochemical properties (on wet weight basis) of fish sausage during frozen storage at -18°C for 120 days

Trial & storage time	pH value	TVBN (mg/100g)	TMA (mg/100g)	TBA (mg MDA/kg)
Zero time				
Control	8.28±0.012	19.89±0.018	7.90±0.010	0.341±0.010
Black seed	8.06±0.015	14.22±0.015	6.17±0.012	0.333±0.011
Jojoba	8.00±0.014	14.99±0.012	6.70± 0.015	0.312±0.013
Chamomile	7.99±0.021	14.73±0.018	5.14±0.013	0.253±0.014
Parsley	7.84±0.016	14.27±0.017	6.73±0.012	0.278±0.012
After 60 days				
Control	8.33±0.015	20.01±0.018	7.92±0.021	0.344±0.011
Grape	8.11±0.020	14.30±0.016	6.25±0.034	0.337±0.012
Green tea	8.05±0.016	15.18±0.020	6.73±0.040	0.324±0.015
Orange	8.08±0.012	14.90±0.022	5.33±0.035	0.270±0.013
Rosemary	7.90±0.013	14.47±0.014	6.80±0.030	0.283±0.014
After 120 days				
Control	8.37±0.020	20.12±0.022	8.01±0.014	0.347±0.014
Grape	8.14±0.017	14.38±0.020	6.33±0.012	0.340±0.015
Green tea	8.09±0.015	15.37±0.021	6.81±0.015	0.336±0.018
Orange	8.17±0.012	15.08±0.020	5.57±0.018	0.286±0.017
Rosemary	8.04±0.013	14.66±0.023	6.96±0.019	0.288±0.019

Data are calculated as mean ± (SD) Standard deviation; n=3. Total volatile basic nitrogen (TVB-N), Trimethylamine nitrogen (TMA-N), thiobarbituric acid (TBA)

Table 4. Effect of different plant extracts on physicochemical properties (on wet weight basis) of fish burger during frozen storage at -18°C for 120 days

Trial & storage time	pH value	TVBN (mg/100g)	TMA (mg/100g)	TBA (mg MDA/kg)
Zero time				
Control	8.39±0.010	15.86±0.019	5.16±0.017	0.347±0.015
Black seed	8.13±0.011	13.89±0.017	5.18±0.022	0.340±0.016
Jojoba	8.06±0.009	11.03±0.015	3.19±0.021	0.336±0.017
Chamomile	7.97±0.012	12.32±0.016	3.21±0.027	0.286±0.014
Parsley	7.97±0.018	11.38±0.012	2.65±0.025	0.288±0.019
After 60 days				
Control	8.47±0.012	16.10±0.011	5.34±0.021	0.344±0.010
Black seed	8.21±0.011	14.17±0.010	5.23±0.020	0.337±0.012
Jojoba	8.10±0.014	11.09±0.013	3.22±0.018	0.324±0.019
Chamomile	8.03±0.016	12.41±0.0.17	3.36±0.015	0.270±0.018
Parsley	8.03±0.017	11.55±0.018	2.76±0.012	0.283±0.013
After 120 days				
Control	8.54±0.012	16.35±0.017	5.52±0.014	0.341±0.010
Black seed	8.28±0.015	14.46±0.015	5.28±0.016	0.333±0.018
Jojoba	8.14±0.014	11.16±0.013	3.26±0.018	0.312±0.019
Chamomile	8.08±0.018	12.51±0.012	3.52±0.017	0.253±0.015
Parsley	8.08±0.013	11.73±0.018	2.87±0.018	0.278±0.040

Data are calculated as mean ± (SD) Standard deviation; n=3. Total volatile basic nitrogen (TVB-N), Trimethylamine nitrogen (TMA-N), thiobarbituric acid (TBA)

The effect of different plant extracts on the physicochemical properties (%, on wet weight basis) of the Nile tilapia fish burger during frozen storage (-18°C) for 120 days are illustrated in Table (4). The results showed that, the pH value, TVBN (mg/100g), TMA (mg/100g), TBA (mg MDA/kg) of the control, black seed, jojoba, chamomile, parsley of the Nile tilapia fish burger at zero time were (8.39, 8.13, 8.06, 7.97, 7.97); (15.86, 13.89, 11.03, 11.32, 11.38 mg/100g); (5.16, 5.18, 3.19, 3.21, 2.65 mg/100g) and (0.347, 0.340, 0.336, 0.286, 0.288 mg MDA/kg), respectively. They witnessed a change after 60 days of frozen storage to record (8.47, 8.21, 8.10, 8.03, 8.03); (16.10, 14.17, 11.09, 12.41, 11.55 mg/100g); (5.34, 5.23, 3.22, 3.36, 2.76 mg/100g) and (0.344, 0.337, 0.324, 0.270, 0.283 mg MDA/kg), respectively. While, these values reached records of (8.54, 8.28, 8.14, 8.08, 8.08); (16.35, 14.46, 11.16, 12.51, 11.73 mg/100g); (5.52, 5.28, 3.26, 3.52, 2.87 mg/100g) and (0.341, 0.333, 0.312, 0.253, 0.278mg MDA/kg), respectively at the end of the frozen storage at -18°C. For the pH value of fish sausage and burger during freezing storage, the increase recorded is due to the presence of alkaline compounds resulted from protein decomposition **(Lago *et al.*, 2019)**. The increase of TVB-N values during storage is attributed to the activity of endogenous and microbial protolytic enzymes, which results in breaking down the proteins into volatile nitrogenous compounds **(Yassin & Abo-Taleb, 2007; Bekhit *et al*., 2021)**. In addition, the increase in the TBA values may be attributed to the autoxidation of fish fat and the formation of some TBA-reaction substances during storage **(El-Akeel, 1988; Domínguez *et al*., 2019)**.

Sensory evaluation of Nile tilapia fish sausage and burger

The effect of different essential oils on sensory scores of the Nile tilapia fish sausage during frozen storage for 120 days at (-18°C) are given in Table (5). The results revealed that, color, flavor, taste, tenderness, juiciness and overall acceptability of control, grape, green tea, orange and rosemary of the Nile tilapia fish sausage at zero time were (8.00, 9.00, 9.00, 9.00, 9.00); (8.00, 8.50, 8.25, 8.20, 8.30);(8.00, 8.50, 8.50, 8.50, 8.40);(8.00, 8.20, 8.15, 8.25, 8.10);(8.00, 8.25, 8.20, 8.25, 8.30) and (8.00, 9.00, 9.00, 9.00, 9.00) respectively. Values recorded a change after 60 days of frozen storage marking (87.50, 8.50, 8.50, 8.50, 8.50); (7.50, 8.00, 8.15, 8.15, 8.20);(7.50, 8.00, 8.00, 8.00, 8.00) and (7.50, 8.00, 8.10, 8.00, 8.15) respectively. While, these values significantly decreased to record (7.00, 7.50, 7.50, 7.50, 7.50); (7.00, 7.50, 7.50, 7.50, 7.50); (7.00, 7.50, 7.50, 7.50, 7.50); (7.00, 7.50, 7.50, 7.50, 7.50); (7.00, 7.50, 7.50, 7.50, 7.50) and (7.00, 7.50, 7.50, 7.50, 7.50), respectively at the end of frozen storage at -18°C.

Table (6) explains the effect of different essential oils on the sensory scores of the Nile tilapia fish burger during frozen storage for 120 days at -18°C. The results stated that, color, flavor, taste, tenderness, juiciness and overall acceptability of control, black seed, jojoba, chamomile, parsley of the Nile tilapia fish sausage at zero time were (8.50, 8.50, 8.50, 8.50, 8.50);(8.00, 8.50, 9.00, , 8.50); (8.00, 8.50, 9.00, 9.00, 8.50); (7.50,

8.00, 8.50, 8.50, 8.00); (7.50, 8.00, 8.50, 8.50, 8.00) and (8.00, 8.50, 9.00, 9.00, 8.50), respectively.

Table 5. Effect of different plant extracts on sensory scores of fish sausage during frozen storage at -18°C for 120 days

Trial & storage time	Color	Flavor	Taste	Tenderness	Juiciness	Overall acceptability
Zero time						
Control	8.00	8.00	8.00	8.00	8.00	8.00
Grape	9.00	8.50	8.50	8.20	8.25	9.00
Green tea	9.00	8.25	8.50	8.15	8.20	9.00
Orange	9.00	8.20	8.50	8.25	8.25	9.00
Rosemary	9.00	8.30	8.40	8.10	8.30	9.00
After 60 days						
Control	7.50	7.50	7.50	7.50	7.50	7.50
Grape	8.50	8.00	8.00	8.00	8.00	8.00
Green tea	8.50	8.15	8.20	8.00	8.10	8.00
Orange	8.50	8.15	8.10	8.00	8.00	8.00
Rosemary	8.50	8.20	8.00	8.00	8.15	8.00
After 120 days						
Control	7.00	7.00	7.00	7.00	7.00	7.00
Grape	7.50	7.50	7.50	7.50	7.50	7.50
Green tea	7.50	7.50	7.50	7.50	7.50	7.50
Orange	7.50	7.50	7.50	7.50	7.50	7.50
Rosemary	7.50	7.50	7.50	7.50	7.50	7.50

On the other hand, values were changed after 60 days of frozen storage, recording (8.00, 8.00, 8.00, 8.00, 8.00); (7.50, 8.00, 7.50, 8.00, 7.50);(7.50, 8.00, 7.50, 8.00, 7.50); (7.00, 8.00, 7.50, 8.00, 7.50) and (7.50, 8.00, 8.00, 8.00, 8.00), respectively. While, these values significantly decreased to record (7.00, 7.50, 7.50, 7.50, 7.50); (7.00, 7.50, 7.50, 7.50, 7.50); (7.00, 7.50, 7.50, 7.50, 7.50);(7.00, 7.50, 7.50, 7.50, 7.50);(7.00, 7.50, 7.50, 7.50, 7.50) and (7.00, 7.0,7.00, 7.00), respectively at the end of frozen storage at -18°C.

The values of sensory score showed no significant differences among the four additives in fish sausage; however, they were better than those of the control. While, fish sausage with orange and grape were better than that with green tea and rosemary extracts in flavor and tenderness. On the other hand, the values of flavor, taste, tenderness, juiciness and the overall acceptability were determined for fish burger processed using Jojoba and chamomile plant extracts.

Table 6. Effect of different plant extracts on sensory scores of fish burger during frozen storage at -18°C for 120 days

Trial & storage time	Color	Flavor	Taste	Tenderness	Juiciness	Overall acceptability
Zero time						
Control	8.50	8.00	8.00	7.50	7.50	8.00
Black seed	8.50	8.50	8.50	8.00	8.00	8.50
Jojoba	8.50	9.00	9.00	8.50	8.50	9.00
Chamomile	8.50	9.00	9.00	8.50	8.50	9.00
Parsley	8.50	8.50	8.50	8.00	8.00	8.50
After 60 days						
Control	8.00	7.50	7.50	7.00	7.00	7.50
Black seed	8.00	8.00	8.00	8.00	8.00	8.00
Jojoba	8.00	7.50	7.50	7.50	7.50	8.00
Chamomile	8.00	8.00	8.00	8.00	8.00	8.00
Parsley	8.00	7.50	7.50	7.50	7.50	8.00
After 120 days						
Control	7.00	7.00	7.00	7.00	7.00	7.00
Black seed	7.50	7.50	7.50	7.50	7.50	7.00
Jojoba	7.50	7.50	7.50	7.50	7.50	7.00
Chamomile	7.50	7.50	7.50	7.50	7.50	7.00
Parsley	7.50	7.50	7.50	7.50	7.50	7.00

CONCLUSION

The results deduced that, the proximate compositions, the physicochemical and sensory properties of processed fish products differed among samples as different ratios of plant extracts were used in their preparation. On the other hand, moisture, protein, lipids, color, flavor, taste, tenderness, juiciness and overall acceptability were significantly decreased during the frozen storage period of both sausage and burger. Meanwhile, the values of ash, pH value, TVBN, TMA and TBA were significantly increased during the same period. Rejected by most consumers, overweight Aswan-tilapia can be exploited to produce some ready- to- eat products. Furthermore, although plant extracts (essential oils) didn't markedly affect fish chemical composition, they improved quality and sensory attributes of sausage and burger products during the frozen storage periods.

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