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Keeping The Quality Of Refrigeration Stored Catfish (*Clarias Gariepiunun*) Patties Using The Ethanolic Extract Of Irradiated Miswak (*Salvader Persica L*) Sticks

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Abstract

The aim of the present work was to study the possibility of using the ethanolic extract of the irradiated miswak for keeping the quality of catfish patties during refrigerated storage. Five batches of catfish patties were formulated withe the ethanolic extract of 2kGy irradiated miswak at levels of 0, 1, 1.5, 2 and 2.5 ml/100g. Samples of catfish patties were cold storage at 4± 1^0Cfor 20 daysand theirmicrobiological, physicochemical and sensory properties were determined. The results showed that total bacterial count, total psychrophilic bacteria and the counts of molds and yeastswere significantly increased during cold storage, but the rate of microbial increase significantly lowered by increasing extract levels. While coliform bacteria and *Staphylococcus aureus* were not detected in all samples. Also the values of pH and contents of TVBN, TMA and TBA for samples showed similar observation as these values significantly increased during cold storage but at lower rates with increasing the level of the added extract. Cooked samples forall formulation patties were highly acceptable taste and texture on day zero of storage. Also raw samples were highly acceptable appearance and odor. Formulation of catfish patties treated with the miswak extract1, 1.5, 2 and 2.5 ml/100g shows retarded appearance of mold growth on the surface of samples and off- odor detection as signs of spoilage after14, 16, 18 and 18days of cold storage, respectively, as compared to 10 days for control samples. Therefore, the ethanolic extract of 2 kGy irradiated miswak can be successfully used at level 2 ml/100g for keeping quality and safety of fish patties.

Keywords: Catfish, Catfish Patties, Miswak, miswak extract, Irradiated miswak, Food Irradiation and Gamma rays

1. Introduction

Fish meat is one of the most valuable muscle food being a valuable source of high grade protein, biologically active and easily digestible lipids in addition to different important minerals and vitamins. Among fish species, catfish constitutes valuable species for aquaculture with high nutritional value and provides essential nutrients for human. The demand for catfish is not limited to the whole fish or it's fillets but also for its processed products [1, 2,3]. In the today's world, consumers showed increases preference in buying ready-made fast foods to save time, particularly those with busy life styles and modern living, in addition to growing interest in producing different ready- prepared fish products[4, 5]**.** However, fish and their products are the most perishable muscle foods with a limited shelf – life which is restricted by enzymatic and microbial spoilage in addition to liquid oxidation[6, 7]**.** On the other hand, increasing interest has been recently focused on consumingnatural products and several natural additives have been broadly examined as alternatives to the synthetic food additives[8, 5]**.**

Miswak sticks **(***Salvador persica* **L)** contain a number of phytochemicals with antiseptic, antibacterial and antioxidant activates. Screening of their different extracts revealed the presence of sterols, terpenes, flavonoids, flavone aglycone, saponins, tanins, alkaloids and isothiocyanate [9, 10, 11]**.** Studies have shown that gamma irradiation, as an efficacious viable technology addressing both food safety and quality, can increase the contents of certain phytochemical and enhance their antioxidant activity and biological value [12]**.** Furthermore, the results of recently studyshowed that irradiation of miswak at a

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maximum dose of 2 kGy were significantly increased its antimicrobial and antioxidant activity and its extract can be applied in food preservation as a natural source[9]**.** Therefore, the present work aims to study the potential of using the ethanolic extract of irradiated miswak for keeping quality of catfish patties during refrigerated storage.

2. Materials and methods:

Materials:

Freshly caught catfish (*clarias garieapinns*) with average weight of 2-3 kg were obtained from the production ponds of central laboratory for aquaculture at Abbassa, Abu Hammad district, Al Sharkia Governorate, Egypt. Spices (cumin, black pepper, theyme and red pepper), salt (sodium chloride), potatoes, onion, egg, bread, flour, and miswak sticks (*salvadora persica* L.) were purchased from the local markets in Zagazig city, Al – Sharkia Governorate, Egypt.

Chemicals and reagents:

Microbiological media (manual manufactured by Sigma company, St. Louis, Mo, USA) were purchased from local chemical companies. Solvents and chemicals were of analytical grade and purchased from El- Gomhoria Company for chemicals and Drugs, Cairo, Egypt.

Preparation of the ethanalic extract of irradiated miswak:

The ethanolic extract of irradiated miswak was prepared as previously described [9]**.** Briefly, the stem bake of miswak (*S. persicaL*) was dried at 55^0 C for 3 days in an oven the dried miswak stems were sliced into discs and ground into fine powder using a cafe grinder. The fine powder of miswak was subjected to gamma irradiation at dose of 2 kGy (the optimum dose depending on the result of the previous study) using an experimental ^{60}CO Russian Gamma chamber (providing a dose ratio of 665.6 Gy/h), the Cyclotron project, Nuclear Research Center, EgyptianAtomic Energy Authority. Theses the ethanolic extract was prepared by soaking of the irradiated miswak powder in 70% ethanol (at ratio of 50 g/L) in a closed container for 48 hours at room temperature. After filtration with whatman No1 filter paper, the ethanolic filtrate was evaporated at 50^0C using vacuum evaporator and the observed extract was kept in dark vial at -18^0C until use.

Preparation of Catfish patties:

The obtained freshly caught catfish were directly transferred to the laboratory in an ice chest. Catfish were beheaded, gutted, skinned, washed under tap water and boiled for 2-3 min in boiling water. Then bones were removed and the obtained flesh was mined using a kitchen blender. On the other hand, clean washed potatoes were pealed, cooked in boiling water until being easily poken with a fork (≈ 15-20 min) and mashed. While bread was wetted by water and drained.

The prepared ingredients were used for preparation of five batches of patties. The main formula for all batcher consisted of minced catfish (81%), mashed potatoes (6%), sodium chloride salt (0.7%), bread (0.9%), onion (4%), whole liquid egg (1%), cumin (0.5%), black pepper (0.4%), thyme (0.5%) and red paper (5%) as described by [13]**.** The miswak extract was added at level of 0,1.0, 1.5, 2.0 and 2.5 ml/100g of each of the prepared batches of the main formula, respectively. Ingredient were mixed thoroughly and homogenized in the blender. Then patties form each batch were formed by hand, coated with wheat flour and packaged in polyethylene pouches. Pouches were sealed by heated, and cold stored at 4±1^0C, then samples were subjected to the periodical analysis at 2 days integral until the rejection of sample.The rejection of samples was based on the total bacterial count (1×10^6 cfu/g as a maximum acceptable count) or detection of unacceptable appearance or odor.

Analytical methods:

Microbiological analysis:

Total bacterial count and total psychrophilic bacteria were enumerated on plate count agar media according to [14]**.** The counts of molds and yeasts were determined using oxytetracycline yeast extract agar media according to the **Oxoid manual** [15]**.**Staphylococcusaureus was counted on Baird parker agar media according to [15]**.**The count of coliform group was enumerated using violet red bile agar according to the **Oxoid manual** [15]**.**

Chemical analysis:

The content of moisture, protein, fats and ash were determined according to the **AOAC** [16] official methods, while total carbohydrates were calculated by difference according to **Egan *et al***[17]. PH value was assessed as described by **Carballo *et al***[18]. Total volatile basis nitrogen and trimethylamin contents were determined according to the **AMC methods** [19]. Thiobarbituric acid was determined as described by **Tarladgis *et al***[20].

Sensory evaluation:

All samples of catfish patties under investigation were subjected to sensory evaluation for appearance, odor, taste and texture. Taste and texture of samples were evaluated after deep frying in sunflower oil on day zero of storage only (for safety precautions). While appearance and odor of samples were evaluated at zero time and during cold storage of raw samples at 4± 1^0C. The panelists consisted of five staff members of our laboratory. Quality of sensory characteristics was assessed by a nine hedonic scale according to **Yerlikaya *et al***[13]. Scores of 7-9 indicate very good quality, while scores of 4-6.9 indicate good quality; meanwhile scores of 1 – 3.9 indicate rejected samples.

Statistical analysis:

In all determination, three poaches from each of catfish formulations were used and analysis were carried out using triplicate samples (n=3). The results were statistically analyzed using **SPSS**[21] and results were recorded as mean ± standard error.

3. Results and discussion:

3.1. Effects of ethanolic extract of irradiated miswak on microbiological quality of catfish patties during cold storage (4± 1^0C):

Total bacterial counts in catfish patties samples formulated with the different levels of the miswak extract were determined during cold storage (4± 1^0C) and the results are shown in Figure (1). As shown all samples had similar initial total bacterial counts. The initial $\log_{10}$ for total bacterial counts on day zero were 5.14, 5.01, 5.01, 5.03 and 5.02 cfu/g in samples formulated with 0, 1, 1.5, 2 and 2.5 ml/100g of the miswak extract. Storage of samples at 4± 1^0C significantly increased the total bacterial count for all samples under investigation but the rate of increase was lowered with increasing the level of the added miswak extract. The total bacterial counts exceeded the maximum acceptable limit (1× 10^6 cfu/g according to **NFSA,**[22] and the Egyptian standards. **ESO,**[23] after 10 days of cold storage for control samples and their mean $\log_{10}$ count reached 6.44 cfu/g. meanwhile the mean $\log_{10}$ for the total bacterial counts were 6.24, 6.18, 6.11 and 6.11 cfu/g in catfish patties formulated with the levels of 1, 1.5, 2 and 2.5 ml/100g of miswak extract after 14, 16, 20 and 20 days of cold storage, respectively. Different studies reported the increase of total bacterial counts during cold storage of different fish products [24, 25]**.**

The results in Figure (2) represent the counts of total psychrophilic bacteria during cold storage of catfish patties formulated with the different levels of the miswak extract.

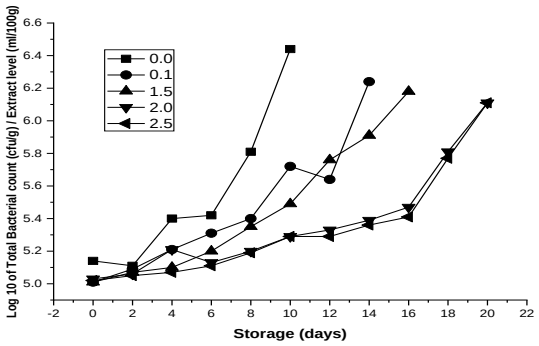

Fig.1: Log 10 of total bacterial count (cfu/g)of cold stored (4±1°c) catfish patties as affected by formulation with the ethanolic extract of irradiated miswak

Similar initial counts of total psychrophilic bacteria were also observed for all formulated samples at zero time of cold storage. However significant gradual increases in the counts of total psychrophilic bacteria were observed in all samples during their cold storage (4± 1^0C). Increasing the level of the added miswak extract, significantly decreased the rate of bacterial increases during storage of the different formulated catfish patties (Figure 2). The increase of total psychrophilic bacteria during cold storage was also reported by [26, 27]**.**

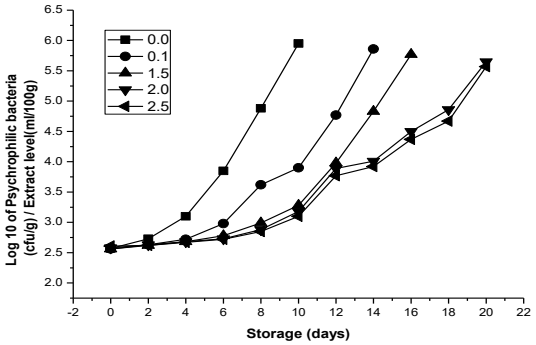

Fig. 2: Log 10 of total psychrophilic bacteria of cold stored (4±1°c) catfish patties as affected by formulation with the ethanolic extract of irradiated miswak

The enumeration of total molds and yeasts also revealed that samples of all formulated catfish patties had similar initial count on day zero of cold storage. The mean $\log_{10}$ counts for total molds and yeasts were 1.15, 1.20,1,19, 1.19 and 1.19 cfu/g in

samples formulated with the miswak extract at levels of 0, 1, 1.5, 2 and 2.5 ml/100g respectively (Figure 3). The same table shows that the counts of molds and yeasts significantly increased during cold storage (4± 1^0C) forall samples but also lower rates of increase were observed with increasing miswak extract levels as shown in Figure (3). **Abbas *et al,*** [25]**and Elhanafy** [26] also reported the increase of molds and yeasts in cold stored fish products.

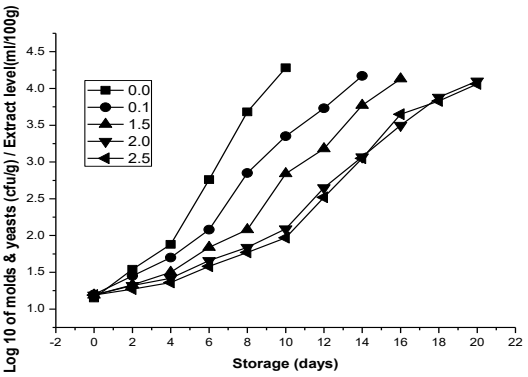

Fig. 3: Log 10 of total molds and yeasts of cold stored (4±1°c) catfish patties as affected by formulation with the ethanolic extract of irradiated miswak

Furthermore, samples of catfish patties under investigation were examined for the presence of coliform bacteria and *staphylococcus aureus* but these bacteria were not detected in all formulated samples. From the results of microbial determinations in this study, it is apparent that the ethanolic extract of the irradiated miswak significantly decreased the rate of increase for all microbial counts during cold storage leading to the extension of the shelf life for 12, 14, 18 and 18 days for samples formulated with the miswak extract at levels of 1, 1.5, 2 and 2.5 ml/100g, respectively. These results also reflect the antimicrobial effect of the ethanolic extract of the irradiated miswak in the formulated catfish patties.

3.2.Physicochemical quality attributes of catfish patties as affected by formulation with the ethanolic extract of the irradiated miswak:

The proximate chemical composition of samples of catfish patties under investigation was determined. The results showed that the mean content of moisture was 68.62%, while the mean of contents from protein, fat, ash and carbohydrate on day weight basis were 61.93, 16.71, 3.47 and 17.87%, respectively (data not presented).

The changes in pH values were determined in all formulated catfish patties during their cold storage at 4± 1^0C(table 1). Samples of all formulated catfish patties had similar initial pH value at zero time of cold storage. Cold storage, however induced slight gradual increase in the pH values for all samples under study. However, the rate of increase was lower with increasing of the added miswak extract as shown in table 1. The observed increases in the pH values might be due to the formation of nitrogen derivatives during storage of samples. Similar results were observed by **Abbas *et al*.,**[25]**.**

Table 1: pH values of cold stored (4± 1°C) catfish patties as affected by formulation with the ethanolic extract of irradiated miswak.

Storage (days)	Miswak extract level(ml/100g) /PH Values				
	0.0	**1.0**	**1.5**	**2.0**	**2.5**
0	6.38±.035A	6.39±.035A	6.39±.023A	6.39±.015A	6.42±.029A
2	6.42±.069A	6.41±.055A	6.40±.173A	6.41±.115A	6.41±.055A
4	6.45±.058A	6.44±.035A	6.42±.015A	6.43±.035A	6.44±.020A
6	6.51±.058a	6.50±.029a	6.47±.017A	6.45±.012A	6.46±.023A
8	6.81±.040B	6.66±.023B	6.53±.023A	6.49±.020A	6.50±.055A
10	7.08±.044b®	6.72±.049B	6.61±.060a	6.53±.049A	6.53±.047A
12		6.81±.044b	6.72±.055B	6.62±.053a	6.62±.044a
14		6.96±.029C®	6.88±.016b	6.72±.046B	6.71±.035B
16			6.97±.023C®	6.84±.023b	6.82±.020b
18				6.91±.018C	6.90±.024C
20				6.98±.028C®	6.96±.016C®

Means with the same capital letter in the same rows are not significantly different, means with the same small letter in the same columns are not significantly different ® Rejected Samples

Table (2) represents the contents of total volatile basic nitrogen (TVBN) during cold storage of catfish patties as affected by formulation with the extract of irradiated miswak at different levels. All formulated samples had similar contents of TVBN at

Zero time of storage being 5.32, 5.32, 5.32, 5.3 and 5.30 mg/100 g for samples formulated with the miswak extract at levels of 0, 1, 1.5, 2 and 2.5 ml/ 100g, respectively. Cold storage (4±1^{0}C) induced significant gradual increased in the contents of TVBA for all samples under investigation but lower rates of increase were observed with increasing the level of the addition of the miswak extract. According to the Egyptian specifications, the maximum acceptable level of TVBN contents in chilled fish is 35 mg/100g **(ESO, No. 3494/ 2005**). As shown in Figure (2) the contents of TVBN exceeded the maximum acceptable limit on days 10, 14, 16, 20 and 20 of cold storage for samples formulated with the miswak extract at level of 0, 1, 1.5, 2 and 2.5 ml/100g, respectively, (the time of the rejection of samples).The contents of TVBN is an irradiator for seafood quality[28] and the increase of TVBN contents might be due to the breakdown of nitrogenous substances due to microbial and enzymatic activity [29, 30]**.** Similar results were reported by[31, 32]**.**

Table 2: Contents of total volatile basic nitrogen (TVBN)of cold stored (4±1°c) catfish patties as affected by formulation with the ethanolic extract of irradiated miswak

Storage (days)	Miswak Extract level(ml/100g)/TVBN (mg N/100 g)				
	0.0	**1.0**	**1.5**	**2.0**	**2.5**
0	5.32±.092A	5.32±.090A	5.32±.070A	5.31±.073A	5.30±.075A
2	9.78±.015a	9.26±.153a	8.97±.401a	8.41±.081a	8.22±.018a
4	16.91±.161B	14.69±.189B	14.18±.120B	13.73±.256B	12.92±.215B
6	22.63±.041b	18.31±.185b	17.52±.023b	16.61±.029b	15.32±.046b
8	28.98±.012C	23.14±.081C	21.36±.035C	20.01±.052C	19.70±.029C
10	37.91±.052c ®	26.81±.029c	24.90±.058c	23.70±.115c	23.00±.069c
12		30.10±.058D	28.31±.063D	26.95±.029D	26.22±.069D
14		36.00±.092d®	31.73±.075d	29.10±.058d	29.02±.041d
16			35.96±.023E®	31.63±.066E	31.50±.115E
18				33.95±.029e	33.77±.069e
20				36.09±.052F®	35.97±.017F®

Means with the same capital letter in the same rows are not significantly different, means with the same small letter in the same columns are not significantly different ® Rejected Samples

The same observations were noticed for the contents of trimethylamine (TMA) in cold stored samples of catfish patties. From table (3), it is apparent that significant gradual increases in contents of TMA were observed in all formulated catfish patties during cold storage of samples but also at lower rate of increase with increasing the level of the added miswak extract. The levels of TMA contents exceeded the maximum acceptable level (10 mg/100g) according to the Egyptian standards **(ESO, NO.3494 / 2005)** on day 10, 14, 16, 20 and 20 of stare for samples formulated with the miswak extract levels of 0, 1, 1.5, 2 and 2.5 ml/100g, respectively (the time of the rejection of samples). The increase of TMA contents during cold storage of fish burger was also reported by [33, 34]**.**

As an indication for oxidation, the contents of thiobarbituric acid(TBA) in the different formulated samples of catfish patties under investigation were determined (Table 4). As shown, similar levels of TBA were observed for all formulated samples at zero time of storage being 0.21, 0.21, 0.20, 0.20 and 0.19 mg malonaldehyde/Kg for samples formulated with miswak extract at levels of 0, 1, 1.5, 2 and 2.5 ml/100g, respectively.

Cold storage significantly increased the contents of TBA in all formulated samples but at lower rate of increase with increasing of the level of the added miswak extract. The levels of TBA exceeded the maximum acceptable level reported by the Egyptian standards**ESO, NO. 3494/2005**(4.5 mg malonaldehyde/Kg) on days 10, 14, 16, 20 and 20 of cold storage for samples formulated with the miswak extract at levels of 0, 1, 1.5, 2 and 2.5 ml/100g, respectively.

Table 3: Contents of trimethylamine (TMA) of cold stored (4±1°c) catfish patties as affected by formulation with the ethanolic extract of irradiated miswak

Storage (days)	Miswak Extract level(ml/100g)/TMA (mg /100 g)				
	0.0	**1.0**	**1.5**	**2.0**	**2.5**
0	0.13±.064A	0.13±.071A	0.12±.061A	0.11±.059A	0.17±.029A
2	1.28±.023a	0.96±.029a	0.88±.012a	0.76±.023a	0.70±.029a
4	2.79±.032B	1.83±.017B	1.60±.058B	1.32±.058B	1.23±.040B
6	5.80±.058b	2.97±.040b	2.23±.058b	1.90±.058b	1.83±.017b
8	9.00±.115C	3.98±.011C	3.01±.070C	2.89±.029C	2.69±.052C
10	14.32±.058c®	6.92±.040c	6.27±.046c	4.90±.029c	4.77±.098c
12		9.80±.087D	8.12±.069D	6.78±.047D	6.50±.029D
14		13.96±.023d®	9.86±.071d	8.20±.115d	7.96±.029d
16			13.82±.103E®	8.72±.075E	8.45±.087E
18				9.71±.051e	9.63±.075e
20				0.11±.059F®	12.98±.069F®

Means with the same capital letter in the same rows are not significantly different, means with the same small letter in the same columns are not significantly different ®Rejected Samples

Table 4: Contents of thiobarbituric acid (TBA) of cold stored (4±1°c) catfish patties as affected by formulation with the ethanolic extract of irradiated miswak.

Storage (days)	MiswakExtract level(ml/100g) / TBA (mg malonaldhyde /kg samples				
	0.0	**1.0**	**1.5**	**2.0**	**2.5**
0	0.21±.035A	0.21±.046A	0.20±.023A	0.20±.035A	0.19±.017A
2	0.72±.070a	0.66±.040a	0.57±.017a	0.46±.036a	0.43±.017a
4	1.81±.052B	0.92±.029B	0.86±.023B	0.65±.029B	0.61±.012B
6	2.76±.092b	1.26±.023b	0.99±.035b	0.867±.020b	0.82±.069b
8	3.99±.035C	1.98±.012C	1.15±.087C	1.10±.058C	1.00±.069C
10	5.26±.075c®	2.83±.017c	1.92±.049c	1.71±.063c	1.64±.080c
12		3.97±.023D	2.83±.017D	2.56±.034D	2.46±.058D
14		4.96±.032d®	3.78±.069d	3.40±.115d	3.37±.040d
16			4.86±.035E®	3.69±.052E	3.69±.109E
18				4.00±.069e	3.92±.015e
20				4.82±.064F®	4.90±.086F®

Means with the same capital letter in the same rows are not significantly different, means with the same small letter in the same columns are not significantly different ® Rejected Samples

The obtained results reveal that the ethanolic extract of the irradiated miswak excreted an antioxidant activity and retarded the oxidation in catfish patties during cold storage of samples. Many authors reported the increase of TBA contents during cold storage of different fish products [26,31,34]**.** They reported that the TBA is a secondary breakdown product of fat oxidation and widely used as an indicator of degree of fat oxidation**.**

3.3.Sensory properties of catfish patties as affected by formulation with the ethanolic extract of the irradiated miswak:

The acceptability of the formulated catfish patties under investigation was examined by sensory evaluation of samples for appearance, odor, taste, and odor (table 5). As shown in table 5 a&b, all raw samples of the formulated catfish were highly acceptablescores for appearance and odor on day zero of cold storage,while cooked samples were highly acceptable scoresfor their taste and texture at zero time of cold storage as shown in table 5c. During cold storage of samples at 4 ± 1^0C, the mold growth started to appear on the surface of the control samples in addition to off-odor detection on day 10 of storage and samples were rejected. However formulation of catfish patties with the miswak extract at levels of 1, 1.5, 2 and 2.5 ml / 100g could retard the detection of these signs of spoilage which started to appear on days 14, 16, 18 and 18 of cold storage of the formulated samples, respectively (table 5 a&b).Therefore, samples formulated with the miswak extract at these applied ascending levels had an acceptable refrigerated shelf-life of 12, 14, 16 and 16 days, respectively as compared to 8 days for the control samples based on the sensory evaluation scores.

Table 5 (a): Appearance of of cold stored (4±1°c) catfish patties as affected by formulation with the ethanolic extract of irradiated miswak

Storage (days)	Miswak Extract level(ml/100g)/Appearance of scores				
	0.0	1.0	1.5	2.0	2.5
0	8.83±0.167A	8.9±0.100A	9.00±0.00A	9.00±.000A	9.00±.000A
2	8.73±.145A	8.60±.100a	8.80±.058a	8.93±.067Aa	8.93±.033A
4	8.53±.145A	8.47±.120a	8.53±.033B	8.60±.100a	8.60±.000a
6	8.47±.120A	8.33±.088a	8.37±.067B	8.50±.058B	8.50±.000B
8	7.50±.321a	8.03±.033a	8.10±.058b	8.37±.067b	8.13±.067b
10	2.30±.551B®	7.43±.067B	7.77±.145C	8.07±.067C	7.93±.120C
12		5.33±.491b	6.93±.033c	7.77±.120C	7.47±.120c
14		3.47±.260C®	5.90±.058D	6.73±.433c	6.70±.252D
16			3.57±.067d®	5.87±.033D	5.87±.296d
18				5.17±.088d	5.37±.033E
2o				3.57±.120E®	3.20±.100e®

Means with the same capital letter in the same rows are not significantly different, means with the same small letter in the same columns are not significantly different ® Rejected Samples

Table 5 (b): Odor of cold stored (4±1°c) catfish patties as affected by formulation with the ethanolic extract of irradiated miswak

Storage (days)	Miswak Extract level(ml/100g)/ Odor of scores				
	0.0	1.0	1.5	2.0	2.5
0	9.00±.00A	8.9±.066A	8.9±.058A	8.97±.033A	8.90±.058A
2	8.87±.067a	8.70±.100a	8.70±.100A	9.00±.000A	8.80±.058A
4	8.57±.033a	8.47±.033a	8.50±.058a	8.80±.000a	8.57±.033A
6	8.47±.033a	8.33±.033a	8.40±.058B	8.60±.058B	8.47±.033a
8	7.50±.300B	7.93±.067B	8.07±.067B	8.47±.145B	8.20±.058B
10	2.80±.416b®	7.00±.058b	7.30±.252b	8.17±.088B	8.00±.058B
12		5.33±.376C	6.60±.208C	7.43±.033b	7.43±.088b
14		3.27±.120c®	5.43±.318c	6.90±.100C	6.60±.200C
16			3.63±.088D®	6.10±.200c	5.60±.321c
18				5.27±.260D	5.43±.203D
20				3.17±.273d®	2.87±.240d®

Means with the same capital letter in the same rows are not significantly different, means with the same small letter in the same columns are not significantly different ® Rejected Samples

Table 5 (c): Taste and texture of cold stored (4±1°c) catfish patties as affected by formulation with the ethanolic extract of irradiated miswak

Properties	Miswak Extract level(ml/100g)/ Mean of scores				
	0.0	1.0	1.5	2.0	2.5
Taste	8.97±.033A	8.97±.033A	9.00±.000A	8.97±.033A	8.90±.058A
Texture	8.83±.167A	8.90±.058A	8.87±.067A	8.97±.033A	8.97±.033A

Means with the same capital letter in the same rows are not significantly different; means with the same small letter in the same columns are not significantly different .

4. Conclusion:

In the present study, the formulation of catfish patties with inclusion of the ethanolic extract of 2kGy irradiated miswak at levels of 1, 1.5, 2 and 2.5 ml/100g significantly decreased the rate of increases in the microbial populations during cold storage of samples parallel a significant decrease in the rate of TVBN, TMA and TBA in samples as compared with the control samples. Furthermore, addition of the miswak extract at the applied assessing levels (1, 1.5, 2 and 2.5 ml/100g) extended the refrigerated shelf life of the formulated catfish patties for 12, 14, 18 and 18 days respectively, compared to only 8 days for the control samples, with highly sensory acceptability of samples. Therefore, it could be concluded that the ethanolic extract of 2 kGy irradiated miswak can be successfully used as a natural safe source for keeping the quality of fish products such as fish patties

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