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The Effect of Using Aqueous Extract of *Cyperus rotundus* Tubers on Characteristics and Shelf Life of Chicken Nuggets

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A B S T R A C T

The experiment was conducted to investigate the effect of the aqueous extract of the *Cyperus rotundus* tubers on fat oxidation and stored frozen chicken nuggets' physical and microbial characteristics. The extract was incorporated into minced poultry meat at concentrations of 0% (control), 0.1%, 0.2%, 0.3%, and 0.4%, and the treated samples were stored for periods of 1 and 30 days at -18°C. The addition of *Cyperus rotundus* extract significantly improved the pH values and water-holding capacity of the treated nuggets (T2, T3, T4, and T5) compared to the control (T1) across both storage durations. Moreover, a notable reduction in lipid oxidation markers (peroxide value (PV), thiobarbituric acid reactive substances (TBA), free fatty acids (FFA), and total volatile nitrogen (TVN) was observed in the treated samples relative to the control. Additionally, a significant decrease in the total coliform bacteria count was evident in the treated nuggets, which inversely correlated with the concentration of the *Cyperus rotundus* extract. The findings suggest that the aqueous extract of *Cyperus rotundus* tubers beneficially affects the quality and safety of chicken nuggets, enhancing their shelf life when stored at -18°C for up to 30 days.

Keywords: *Cyperus rotundus*, chicken nuggets, water holding capacity, peroxide value, natural antioxidants

INTRODUCTION

Fat oxidation is one of the major problems in the meat industry due to the resulting deterioration in flavor, loss of nutritional value and physicochemical properties of meat and meat products such as color, flavor and aroma (1, 2) as well as vitamin deterioration. It is soluble in fats and essential fatty acids (3) and negatively affects the quality of meat and meat products, making them unfit for human consumption (4). The use of industrial antioxidants in preserving meat and meat products has raised many questions about their long-term damage to consumer health (5, 6). Therefore, extensive research studies have been conducted to find natural plant compounds with an antioxidant effect. In addition, they are safe compounds and are a good alternative to industrial compounds that extend the shelf life and enhance the taste and smell of meat and its products. Many researchers have indicated the role of many plants as natural antioxidants and the possibility of using them as preservatives for various types of food and meat and prolonging their storage life by preventing oxidation reactions (7, 8),which include spices such as ginger, black seed, cinnamon, cloves, cumin, and turmeric (9) and herbs such as rosemary and marjoram leaves (10, 11) Many plants have been included in the

generally recognized as safe(GRAS)list proposed by the US Food and Drug Administration (FDA). They are approved for natural preservatives to improve the quality and safety of meat in storage (12,13).

The tubers of *Cyperus rotundus* are considered natural sources, which are used in traditional medicine to treat many diseases that affect humans in India, China, Egypt, Iraq, and Saudi Arabia (14,15). It can be used in whole or in parts directly or to extract materials effectively, including leaves, roots, and tubers. The tubers are the part used medically with antioxidant and anti-cancer effects (16) and anti-bacterial, anti-fungal, anti-inflammatory and anti-obesity (17) due to their high content of antioxidant compounds. The most important are flavonoids, phenols, and tannins (18, 19). Studies have indicated the role of tubers of *Cyperus rotundus* as a preservative and improving the quality and safety of meat and processed meat products when stored, as well as its use as spices, food additives, flavorings, and preservatives for food and meat (19, 20).

Recently, the meat and meat products industry has begun using natural antioxidants because they are safe and do not cause any harm to human health (21) and many studies have proven that natural antioxidants are used for their role in improving the quality of meat and its products and prolonging their shelf life (3,4, 6,9-11, 19).Accordingly, the current study aimed to determine the effect of using aqueous extract powder of *Cyperus rotundus* tubers to improve the qualitative characteristics and prolong the shelf life of chicken nuggets.

MATERIALS AND METHODS

Cyperus rotundus, Preparation and Extraction

Dried *Cyperus rotundus* tubers were obtained from local markets in Baghdad (Al-Shorja markets) and classification was confirmed by presenting it to specialists in the Field Crops Department, College of Agricultural Engineering Sciences, University of Baghdad. This study was conducted at the laboratories of the College of Agricultural Sciences, University of Baghdad on 23/7/2022 and continued for 30 days.

The aqueous extract was prepared according to the method indicated by (22). The tubers were crushed with an electric grinder into a fine powder. Twenty g of the powder was mixed with 400 mL of distilled water in a 1000 mL beaker and the mixture was left in a water bath at 40 °C for 24 h. After that, the mixture was filtered using three layers of gauze. Medical and then using filter paper.

The filtrate was placed in a centrifuge (2500 rpm) for 15 min, after which the filtrate was concentratedto turn it into a thick liquid using a rotary vacuum evaporator to get rid of the water. The filtrate was distributed on nylon bags for one hour until it became a powder, left to dry at laboratory temperature, and stored in a glass bottle in the refrigerator.

Preparing the Nuggets

The study used chicken meat from local markets in Baghdad province, mixing equal amounts of thigh and breast meat (50% breast + 50% thigh).The meat was minced using an electric machine, and salt and a mixture of spices were added to it in the amount of one teaspoon/kg of meat (black pepper, garlic powder, onion powder, cumin, cardamom, coriander, sweet red pepper, cloves, cinnamon). Meat and the ingredients were mixed well to obtain a homogeneous mixture, after which pieces 5 cm long and 3 cm thick were prepared and covered with breadcrumbs (23). These samples were stored by freezing at -18 °C.

Qualitative Measurements of Nuggets

After completing the preparation of the mixture, it was divided into five equal groups (T1, T2, T3, T4, and T5), with the addition of *Cyperus rotundus* tuber aqueous extract at concentrations corresponding to 0% (control), 0.1%, 0.2%, 0.3%, and 0.4% of the meat's weight. To achieve these concentrations, 0, 1, 2, 3, and 4 g of the extract per kg of meat were respectively added. The treated samples were then vacuum-sealed in polyethylene bags and stored at a temperature of -18°C for durations of 1 and 30 days. Throughout the storage periods, all treatments were subjected tophysical, oxidation, and microbial assessments.

Physical Assessment

pH values

It was estimated by using a pH device by homogenizing 10 g of meat (5 g of thigh + 5 gof breast), then adding 100 mL of distilled water to it and homogenizing it with the water well for one min (24).

Water Holding Capacity (%)

The method described by (25) was employed to estimate the water holding capacity (WHC)of meat. This involved taking a 10 g sample of the meat and homogenizing it with 50 mL of distilled water for one min. The mixture was then centrifuged at a speed of 5000 rpm for 10 min. The water holding capacity of the meat was calculated using the following equation: WHC (%) = (Weight of water added- Weight of water after centrifugation) / Sample weight ×100.

Loss During Cooking (%)

The percentage of loss during cooking (LDC) was estimated based on the method outlined by (26). The nuggets were weighed before and after frying to determine the change in weight. The percentage of weight loss during

cooking was calculated using the following equation: LDC (%) = [(Nugget weight before cooking - Nugget weight after cooking) / Nugget weight before cooking] × 100.

Loss Weight When Dissolved

Loss weight when dissolved (LWWD) was estimated according to (27) using the following equation: LWWD (%) = [(Frozen nugget weight - nugget weight after thawing) /Frozen nugget weight]×100.

Indicators of Oxidation

Peroxide Value

The peroxide value (PV)was determined using the method described in (28). Fat from the meat samples was extracted using a Soxhlet apparatus. Initially, the extracted fat, amounting to five grams, was accurately weighed using a precision laboratory balance. This fat sample was then treated with 30 mL of a solvent mixture consisting of glacial acetic acid and chloroform in a 3:2 ratio. Further, 0.5 mL of saturated potassium iodide solution and 30 mL of distilled water were added to the mixture. After the addition of 1 mL of 1% starch indicator, the mixture was titrated with a 0.01 N sodium thiosulfate solution until the disappearance of the blue color. The peroxide value, expressed in milliequivalents per kilogram (meq/kg), was calculated using the formula: PV (meq/kg) = (Number of milliliters of sodium thiosulfate used × 0.01 × 1000) / Weight of the sample.

Thiobarbituric Acid Assay

The thiobarbituric acid (TBA) value was estimated according to the method outlined in (29). Initially, 1 g of meat was homogenized with 25 mL of a cold solution, composed of 20% trichloroacetic acid (TCA) in a 2 M phosphoric acid solution. The homogenate was then transferred into a 50 mL volumetric flask, filled to the mark with distilled water, and shaken well. After this, 25 mL of the mixture was taken and centrifuged at 30,000 rpm for 30 min. The supernatant was then filtered through filter paper. Subsequently, 5 mL of the filtrate was mixed with an equal volume of a 0.005 M TBA reagent solution, prepared in distilled water. A blank was prepared using the same procedure, excluding the meat sample. The mixture was placed in sealed test tubes and allowed to stand for 15 to 16 h at room temperature. After incubation, the samples were heated for 30 min in a water bath. The absorbance of the developed color was measured at a wavelength of 530 nm using a spectrophotometer. The TBA value, expressed as milligrams of malondialdehyde (MDA) per kgof meat, was calculated by multiplying the absorbance at 530 nm by a factor of 5.2: TBA Value (mg MDA/kg) = Absorbance at 530 nm (A530) × 5.2.

Total Volatile Nitrogen

The estimation of total volatile nitrogen (TVN) in meat samples was conducted following the method described in **(28)**. In this procedure, 100 g of minced meat, comprising both breast and thigh portions, was homogenized with 300 mL of a 5% trichloroacetic acid solution. The mixture was then filtered to obtain a clear extract. Subsequently, 5 mL of this clear extract was transferred into a distillation flask, to which 5 mL of sodium hydroxide solution was added. The mixture was heated, and the distillate was collected in a receiver flask containing 15 mL of 4% boric acid solution. A few drops of mixed indicator, comprising methyl red and bromocresol green, were added to this receiver flask. The resulting mixture was then titrated with 0.01 M hydrochloric acid. The total volatile nitrogen content was calculated using the following equation: TVN (mg N/100 g meat) = 14 × (MO + 300) × V / 500 mg, where V represents the volume (in milliliters) of 0.01 M HCl used in the titration, and MO denotes the moisture percentage in the meat sample.

Free Fatty Acids Analysis

The determination of free fatty acids (FFAs) in chicken fat was conducted following the method described in (**28**). The analysis began by placing 10 g of fat, extracted from a meat sample, into a 250 mL capacity flask. To this, a mixture of 25 mL of ether and 25 mL of 95% neutral ethanol was added. Subsequently, 1 mL of a 1% phenolphthalein reagent was incorporated into the mixture. The flask was then continuously shaken while being titrated with a 0.1 N sodium hydroxide solution. The percentage of FFAs, calculated on the basis of oleic acid, was determined using the following formula: FFAs (%) = (Volume of 0.1 N sodium hydroxide in mL × 0.0282) / Weight of the fat sample in g × 100.

Microbial Analysis

The numbers of coliform bacteria were estimated according to the method mentioned by (30) using the dish pouring method. From each decimal dilution, 1 ml was transferred to two empty and sterilized Petri dishes and 15 ml was added to each dish of sterilized culture medium (MRS-Agar). It was prepared instantaneously and kept in a water bath at a temperature of 45°C. After the period of solidification of the culture medium in the dishes, it was kept upside down at a temperature of 37°C for a period of 48 hours. The numbers of bacteria were estimated by multiplying the average number of colonies that grew in each dish with the inverted dilution.

Statistical Analysis

The ready-made statistical program SAS (31) was used and the CRD (Complete Randomize Design) was used in analyzing the data, and the differences between the coefficients of the first experiment were tested using Duncan's multi-level test at a significant level of 0.05 and depending on the following mathematical model: Yij = μ + Ti + eij

RESULTS AND DISCUSSION

Physical Traits

This study investigated the effects of incorporating varying concentrations of dried aqueous extract from *Cyperus rotundus* tubers on the physical attributes of chicken nuggets during storage. The results showed that there was no significant difference between the groups of experimental treatments in pH values on day 1 (Table 1). By day 30 of storage, treatments T4 and T5 exhibited the most pronounced increase in pH when compared to control (P<0.05), suggesting a prolonged preservative effect, with T2 and T3 also showing significant improvements (P< 0.05). The observed pH elevation is likely due to the extract's capacity to enhance water retention, similar to the effect of salts, by increasing electrical repulsion among protein molecules, thereby improving meat binding to water. Additionally, the rise in pH over storage could result from protein decomposition by proteolytic enzymes, increasing nitrogenous compounds that elevate pH levels a critical factor for shelf-life enhancement (32).The reason for the decrease in pH values for the control treatment as the storage period advances could be due to the release of FFAs as a function of lipolytic enzymes; studies have indicated the role of some plant extracts in raising the pH values of meat and meat products stored by freezing (11,33-35).

It is noted that there are no significant differences in the percentage of thawing loss (TL) between the groups of experimental treatments in the first period of storage (1 day), while. The thawing loss during the second storage period (30 days) favored the addition treatments T2, T3, T4, and T5, which recorded a significant decrease compared to the control agent T1.

The data in the same table shows a significant decrease (P<0.05) in the percentage LDC loss of nuggets at one day of storage in favor of treatment T4, which recorded the lowest values compared to the control treatment T1 and then T2. In contrast, the treatments T3 and T5 did not differ significantly between them and compared to the two treatments T2 and T4. At 30 days of storage, the treatments T4 and T5 recorded a significant decrease in the loss during cooking compared to the control treatment T1, followed by the second treatment, while the T3 did not differ significantly as compared to the treatments T2, T4, and T5.

From the same table, the results show that there are no significant differences between the groups of experimental treatments in water retention values during the first period of storage (1 day), while in the second period of storage (30 days) the addition treatments were significantly superior compared to the control treatment T1, as the two treatments T4 and T5 had the highest water retention values, followed by treatment T3, then treatment T2, which did not differ significantly compared to treatment T3 and the control treatment T1, which recorded the lowest water retention values.

Table 1. Effect of adding different concentrations of dried *Cyperus rotundus*aqueous extract on the physical properties of chickennuggets during storage

	Traits							
	pH		WHC (%)		LWWD (%)		LDC (%)	
	Storage time (day)							
Treatment[1]	1	30	1	30	1	30	1	30
T1 (0%)	5.18±0.160 ^{b}	6.060±0.010 ^{c}	52.6±0.09 ^{c}	48.3±0.10 ^{e}	3.90±0.00 ^{a}	6.04±0.18 ^{a}	30.4±0.33 ^{a}	27.4±0.30 ^{a}
T2 (0.1%)	6.07±0.003 ^{a}	6.220±0.020 ^{a}	58.4±0.02 ^{b}	53.5±0.05 ^{d}	2.23±0.01 ^{c}	3.88±0.29 ^{b}	25.5±0.35 ^{b}	22.3±0.39 ^{b}
T3 (0.2%)	6.12±0.003 ^{a}	6.290±0.003 ^{b}	63.5±0.05 ^{a}	55.5±0.04 ^{c}	2.38±0.06 ^{c}	4.17±0.10 ^{b}	24.8±0.28 ^{bc}	20.9±0.37 ^{c}
T4 (0.3%)	6.17±0.003 ^{a}	6.300±0.003 ^{ab}	62.4±0.13 ^{a}	57.2±0.06 ^{b}	2.70±0.06 ^{b}	4.54±0.05 ^{b}	24.1±0.29 ^{c}	21.1±0.52 ^{bc}
T5 (0.4%)	6.21±0.005 ^{a}	6.470±0.090 ^{a}	59.1±0.81 ^{b}	57.5±0.04 ^{a}	2.67±0.06 ^{b}	4.09±0.37 ^{b}	24.9±0.28 ^{bc}	22.0±0.26 ^{bc}

Values are mean ± standard error of the mean. Different letters within the same column for each traits/storage time indicate significant differences between treatments at P≤0.05. [1]Treatments: T1-T5 represent the 0% (control) and 0.1%, 0.2%, 0.3%, and 0.4% concentrations of the dried aqueous extract of tubers of *Cyperus rotundus*, respectively. WHC%, water holding capacity percentage, LWWD, loss weight when dissolved percentage; LDC%, loss during cooking percentage.

The improvement in the physical properties of nuggets treated with different levels of dried aqueous extract is attributed to the role of active compounds in the aqueous extract of *Cyperus rotundus* tubers, including phenolic compounds that have an antioxidant role (36). Various plant extracts have proven their antioxidant role due to their high content. The phenolic compounds, allowing them to be used in foods to replace artificial antioxidants which contribute to protecting the cellular membranes of meat by suppressing free radicals resulting from fat oxidation,

limiting the rupture of cell membranes and preserving them, and reducing the exudation of water from the cells, thus increasing from the ability of meat to hold water and, in return, reducing loss during thawing and cooking (37), as the loss of liquid when thawing causes economic and nutritional loss in addition to its impact on consumer desire, and the percentage of loss increases when thawing during storage, by freezing, ice crystals form inside the muscle cells, which leads to the rupture of the cell membrane of the muscle membrane, which reduces the ability to retain water and thus increases its loss upon thawing. (38). As for the decrease in the ability of meat to retain water during storage for 30 days may be attributed to the decomposition of meat proteins as a result of the tearing of muscle fibers as the storage period progresses, which reduces its ability to hold water. The results of our study were similar to what was found with the results of Kaur et al. (23) when using pomegranate and tomato seed powder in chicken nuggets. Many studies have proven the role of plant extracts in improving the qualitative characteristics of meat and its products (3, 5, 9, 11), while Anjum et al. (32) reported no significant effect on the water retention capacity of nuggets made from chicken meat fed at different levels of flaxseed powder. The results also showed that the treatment of the nuggets with the dried aqueous extract of the tubers of the *Cyperus rotundus* achieved the lowest percentage of loss when thawing and the lowest percentage of loss during cooking, due to the high pH value, which affected the solubility of proteins better when moving away from the electrical neutrality point, and this was reflected in improving the ability of the meat to hold Water.

The results of our study lead to the possibility of using the aqueous extract of dried *Cyperus rotundus*tubers as a natural preservative alternative to industrial antioxidants for preserving meat, as these additives showed high efficiency that contributed to providing stability to the cellular structure of the meat and protecting the sarcoplasmic components and fluids in the membranes from oxidative damage when storing meat, which leads to reducing loss upon thawing, loss during cooking, and an increase in the ability of the meat to hold water, as the integrity of these membranes and the reduction of their rupture contribute to preserving the cellular components of the meat, thus reducing the oozing liquid and improving the ability of the meat to hold water during storage, as high pH values increase the ability to Flesh to carry water (39).

Oxidative Properties

Table 2 shows the effect of adding different levels of aqueous extract of *Cyperus rotundus* tubers on the oxidation indicators of manufactured nuggets and those stored by freezing for 1 and 30 days at -18°C. It is noted from the results that there was a significant decrease (P<0.05) in the peroxide values of the nuggets in favor of the addition treatments compared with the control treatment T1 in the first period of storage, treatment T5 recorded the lowest values, then treatments T4, T3 and T2. while the control treatment recorded T1, and treatment T4 did not differ significantly from treatment T5 on the one hand, and from treatments T3 and T2, which also did not differ significantly compared to the control treatment T1 which recorded the highest values. As for the second period of storage (30 Day) It is noted that there was a significant decrease (P<0.05) in peroxide values in favor of the addition treatments compared to the control treatment T1. Treatments T4 and T5 recorded the lowest peroxide values, followed by treatment T3, and then treatment T2. Treatment T3 did not differ significantly compared to the addition treatments T2, T4, and T5.

From the same table, it is noted that there was no significant differences between the groups of experimental treatments for the values of thiobarbituric acid (TBA) in the first period of storage (1 day). However, in the second period (30 days), it was observed that a significant decrease (P<0.05) occurred for the values of thiobarbituric acid (TBA) in favor of the addition treatments T2, T3, T4, and T5 compared to the control treatment T1. T4 recorded the lowest values, followed by treatments T3 and T5, and then treatment T2. Treatments T3 and T5 did not differ significantly compared to treatments T2 and T4, while the control treatment recorded the highest values. The results of the same table also show a insignificant differences between treatments in the percentage of free fatty acids during the first period of storage, there were no significant differences between the groups of experimental treatments, but in the second period of storage (30 days), the addition treatments T2, T3, T4, and T5 recorded a significant decrease (P<0.05) in the percentage of free fatty acids compared to the control treatment T1, where they recorded treatment T4 had the lowest values, followed by treatment T5, then treatments T2 and T3, while the control treatment recorded the highest percentage of free fatty acids, and the differences were not significant between treatment T5 and treatments T2 and T3. As for the effect of the dried aqueous extract powder of Saad tubers on the total volatile nitrogen concentration of nectar pieces stored in freezer (-18°C) during the two different storage periods (1 and 30 days) according to the data of Table (24), where the differences were not significant between the totals of treatments in the first period. of storage (1 day), while in the second period of storage it was observed that a significant decrease (P<0.05) occurred in favor of the

addition treatments T2, T3, T4 and T5. Treatments T4 and T5 recorded the lowest concentration of total volatile nitrogen, followed by treatment T3 and then T2, which did not differ significantly compared to treatments T3 and T1, while control treatment T1 recorded the highest concentration of total volatile nitrogen.

Table 2. Effect of adding different concentrations of dried *Cyperus rotundus* aqueous extract on the oxidative properties of chicken nuggets during storage

	Traits							
	TVN (mg N/100 g meat)		**TBA (MDA/kg of meat)**		**FFAs %**		**PV (mmeq/kg fat)**	
	Storage time (day)							
Treatment[1]	1	30	1	30	1	30	1	30
T1 (0%)	10.3±0.03 [a]	13.3±0.04 [a]	0.044±0.00 [a]	0.060±0.00 [a]	0.66±0.01 [a]	0.64±0.01 [a]	5.06±0.03 [a]	6.50±0.31 [a]
T2 (0.1%)	9.82±0.02 [b]	11.1±0.03 [b]	0.037±0.00 [b]	0.046±0.00 [b]	0.55±0.01 [b]	0.57±0.01 [b]	4.51±0.01 [b]	4.63±0.01 [b]
T3 (0.2%)	9.74±0.01 [c]	10.7±0.02 [c]	0.034±0.00 [b]	0.041±0.00 [c]	0.54±0.01 [b]	0.52±0.01 [c]	4.25±0.02 [c]	4.48±0.00 [a]
T4 (0.3%)	9.04±0.02 [e]	10.1±0.03 [d]	0.027±0.00 [c]	0.035±0.00 [d]	0.48±0.01 [d]	0.41±0.00 [d]	3.88±0.01 [d]	4.26±0.02 [b]
T5 (0.4%)	9.28±0.03 [d]	10.7±0.16 [c]	0.029±0.00 c	0.038±0.00 [c]	0.50±0.00 [c]	0.45±0.00 [d]	4.19±0.15 [c]	4.34±0.02 [b]

Values are presented as mean ± standard error of mean (SEM). Different letters within the same column for each trait/storage time indicate significant differences between treatments at $P \leq 0.05$. [1]Treatments: T1-T5 represent the 0% (control) and 0.1%, 0.2%, 0.3%, and 0.4% concentrations of the dried aqueous extract of tubers of *Cyperus rotundus*, respectively TVN, total volatile nitrogen; TBA, thiobarbituric acid; FFAs, free fatty acids; PV, peroxide value

Polyphenol-rich plant extracts, such as herbs and spices, have been used for many years to prevent fat oxidation, delay the development of flavors, and improve color stability in meat (40). It has been observed that the direct addition of antioxidants to meat and meat products from polyphenol-rich plants improves their oxidative stability, and overall sensory and nutritional quality for meat and its products and thus increases their shelf life (41). Poultry meat is a perishable food, and with the aim of prolonging its shelf life, modern trends have begun to achieve this goal through the use of natural plant food preservatives to preserve it during the manufacturing stages, as well as reduce the growth of disease-causing microorganisms. (42,43). (33) concluded that adding rosemary powder to minced poultry meat led to a significant decrease (P<0.05) in TBA, PV, FFA and TVN compared to the control. Also Ibrahium et al. (3) indicated the role of plant waste extracts such as grape, orange peel, and peanut shell residues as a good source of natural antioxidants when added to beef turmeric, it improves oxidativ stability and nutritional value and increases the shelf life of storage and Mancini et al. (44) mentioned that adding 3.5% of turmeric powder to rabbit meat turmeric has an antioxidant role, as the values of indicators decreased. Oxidation compared to the control treatment when stored at 4°C for 0 and 7 days. Additionally, Śmiecińska et al. (45) observed an improvement in the physical, chemical and sensory characteristics of rabbit meat and a prolongation of its shelf life when adding 0.35 g of garlic powder/100 g of meat. The results of the study by (19) showed that when treating minced beef with a concentration of 2.5 and 5% of the powder *Cyperus rorundus* tubers resulted in an improvement in the physical and chemical properties and an increase in the shelf life of the meat. Using CRRP at a concentration of 2.5% as a natural preservative in meat products was recommended. It is a rich source of polyphenols and flavonoids and has antioxidant and antibacterial activity. Also, Zangana (11) mentioned that adding a mixture of rosemary and black seed oil at a concentration of 25 mg per kg of meat, it led to a decrease in peroxide values, an improvement in the qualitative quality of chilled minced chicken meat, a prolongation of the storage life, and the possibility of adding them as preservatives while improving the physical and chemical properties. This supports the results of our current study of the decrease that occurred in the values of oxidation indicators in favor of the addition treatments, as the compounds work. Effective in delaying the process of oxidation of fats and inhibiting or preventing the formation of free radicals by donating a hydrogen atom to the free radical, so the radicals become fixed and stable, thus preventing rancid compounds from developing, such as ketones, carboxylates, and aldehydes (46). The results in Table (2) also indicate that the values of total volatile nitrogen (TVN) increased for all treatments after storage for 30 days. This is due to the decomposition of nitrogenous bases during storage, in addition to the activation of proteolytic enzymes or due to microorganisms present in the meat, which leads to an increase in TVN values (47), as the oxidation of proteins is a phenomenon closely linked to degradation processes that can affect meat and meat products and which plays an essential role in meat quality concerning sensory, nutritional and physicochemical properties (21), The results were in agreement with the Iraqi standard (48) for red meat and chilled and frozen chicken meat products, which recommends that TVN values not exceed 20 mg N/100 g meat.

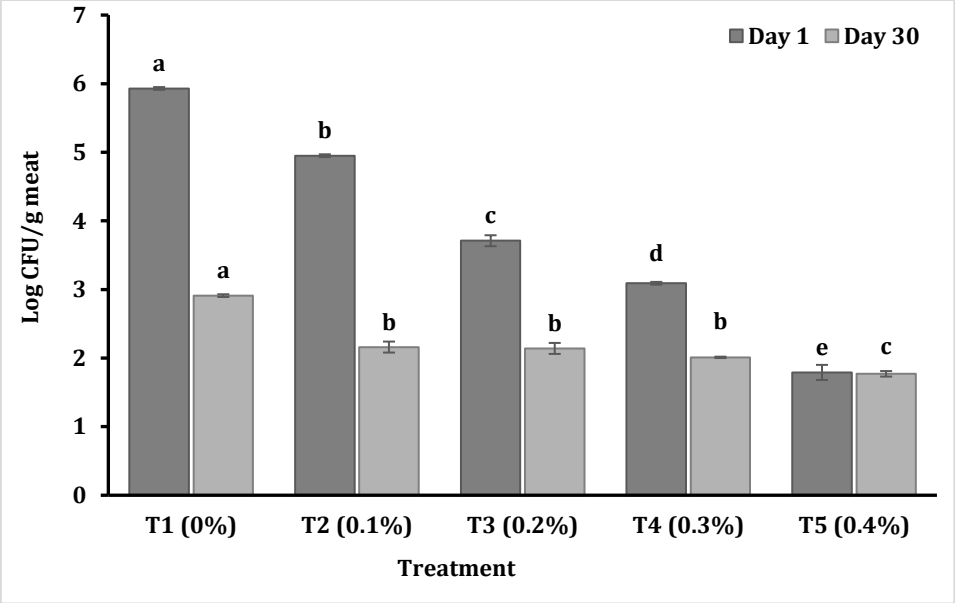

Figure 1. Effect of dried*Cyperus rotundus*aqueous extract on coliform bacteria in chicken nuggets over 30 days of storag. The bacterial counts are presented in logarithmic scale as mean ± standard error of the mean (SEM). Error bars represent the SEM for each treatment group.Each bar denotes the average log colony-forming units (CFU)/g of meat for each treatment at specified storage periods (0 and 30 days). Statistically significant differences between treatments within the same storage period are denoted by differing superscript letters ($P \leq 0.05$)

E. coli Bacteria Count

The results of Figure 1 indicated the effect of treating nuggets with different concentrations of aqueous extract powder of *Cyperus rotundus* tubers was measured by conducting a bacterial count test for coliform bacteria to identify the extent of Its effectiveness in preserving nectar during freeze storage for 1 and 30 days. the microbiological quality standards of the different meat nectarine samples were affected by the addition of dried aqueous extract powder of Nectar plant tubers on the average total number of coliform bacteria in the nectarine pieces during the two different storage periods (1 and 30 days). In the first period of storage. The results show a significant decrease ($P<0.05$) in the total number of coliform bacteria in favor of the addition treatments with an increase in the addition level of aqueous extract powder of *Cyperus rotundus* tubers. Treatment T5 recorded the lowest values, followed by treatment T4, then T3 and T2, while the control treatment T1 recorded the highest values. During the second period of storage, it is noted that there was a significant decrease in the average total number of coliform bacteria for all additional treatments T2, T3, T4, and T5 compared to the control treatment T1. The results we obtained in the current study indicate a decrease in the number of bacteria in the groups of addition treatments in the role of tubers antimicrobial according to what several studies have indicated on the role of the aqueous extract of *Cyperus rotundus* tubers against Gram-positive and Gram-negative bacterial strains (49, 50) both aqueous and ethanolic extracts of the roots of the tubers had antibacterial activity against *E. coli* and *Staphylococcus aureus* (51,52) for the presence of phenolic compounds and flavonoids that are antimicrobial in *Cyperus rotundus*, as these compounds have high antimicrobial effectiveness due to their ability to increase the sensitivity of the bacterial cell wall and cause a change in the permeability of the bacterial wall, which works to damage the bacterial cell wall and its proteins, which facilitates the penetration of these compounds into the wall. The bacterial cell facilitates the transfer of substances into the cells and thus cell death (53). Our results were in agreement with Al-Rubeii et al. (33) who indicated that adding rosemary powder led to a significant decrease in microbial load in child minced chicken meat. Also, Zangana (54) concluded that treating minced chicken meat with the oil extract of rosemary leaves and black seed seeds reduced the microbes load of chicken meat when stored in a freezer, after wards, this attribute to their content of phenolic compounds. As Eltilib et al. (19) indicated that treating ground beef with *Cyperus rotundus* tuber powder at different levels (0, 2.5, and 5%) led to a decrease in the numbers of total bacteria and total coliform bacteria. The results of our current study were in agreement with the Iraqi standard regarding refrigerated and frozen red meat and poultry products issued by the Central Organization for Standardization and Quality Control which stipulated that the total bacterial count should not exceed 710 colony-forming units/g of meat (48).

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N/A

CONFLICT OF INTEREST

Theauthors declare no conflict of interest.

REFERENCES

1. Moczkowska M, Półtorak A, Wierzbicka A. The effect of ageing on changes in myofibrillar protein in selected muscles in relation to the tenderness of meat obtained from cross-breed heifers. Int J Food Sci. Techn. 201752(6):1375-1382. 10.1111/ijfs.13436
2. Soyer A, Özalp B, Dalmış Ü, Bilgin V. Effects of freezing temperature and duration of frozen storage on lipid and protein oxidation in chicken meat. Food Chem. 2010;20(4):1025-1030. 10.1016/j.foodchem.2009.11.042
3. Ibrahium MI, Osheba AS, Nageib AM. Using of some natural antioxidants extracted from food processing wastes for iImprovement quality attributes of beef burger products. Middle East J Appl Sci. 2015;5(4):929-939.
4. Horbańczuk OK, Kurek MA, Atanasov AG, Brnčić M, Brnčić SR. The effect of natural antioxidants on quality and shelf life of beef and beef products. Food Technol Biotechnol. 2019;57(4):439-447. 10.17113/ftb.57.04.19.6267
5. Ribeiro JS, Santos MJ, Silva LK, Pereira LC, Santos IA, da Silva Lannes SC, et al. Natural antioxidants used in meat products: A brief review. Meat Sci. 2019;1(148):181-188. 10.1016/j.meatsci.2018.10.016
6. Munekata PE, Rocchetti G, Pateiro M, Lucini L, Domínguez R, Lorenzo JM. Addition of plant extracts to meat and meat products to extend shelf-life and health-promoting attributes: An overview. Curr Opin Food Sci. 2020;1(31):81-87. 10.1016/j.cofs.2020.03.003
7. Lorenzo JM, Pateiro M, Domínguez R, Barba FJ, Putnik P, Kovačević DB, et al. Berries extracts as natural antioxidants in meat products: A review. Food Res Int. 2018;1(106):1095-1104. 10.1016/j.foodres.2017.12.005
8. Smaoui S, Hlima HB, Mtibaa AC, Fourati M, Sellem I, Elhadef K, et al. Pomegranate peel as phenolic compounds source: Advanced analytical strategies and practical use in meat products. Meat Sci. 2019;1(158):107914. 10.1016/j.meatsci.2019.107914
9. Al-Salmany AS, saleh AL-Rubeii AM. Effect of cinnamon and turmeric nanoparticles extract in quality characteristics of ground beef during freeze storage. Plant Arch. 2020;20(1):350-356.
10. Brannan RG. Effect of grape seed extract on physicochemical properties of ground, salted, chicken thigh meat during refrigerated storage at different relative humidity levels. J Food Sci. 2008;73(1):36-40. 10.1111/j.1750-3841.2007.00588.x
11. Zangana BS. The synbiotic effect of volaticle oil extracted from leaves*Rosmarinusofficinolis* and *Nigella*sativa on chemical composition, physical characteristic and oxidation attributes of minced poultry meat during cold storage. Iraqi J Market Res Consum Prot. 2015;7(1):144-164.
12. Aguilar F, Autrup H, Barlow S, Castle L, Crebelli R, Dekant W, et al. Use of rosemary extracts as a food additive-Scientific opinion of the panel on food additives, flavourings, processing aids and materials in contact with food. EFSA J. 2008;721,1-29. 10.2903/j.efsa.2008.721
13. Morissette R, Mihalov J, Carlson SJ, Kaneko KJ. Trends in ingredients added to infant formula: FDA's experiences in the GRAS notification program. Food Chem Toxicol. 2023;178:113876. 10.1016/j.fct.2023.113876
14. Al-Nuimi SM. Effect of *Cyperus rotundus* tubers boiled extract on some physiological and biochemical parameters aspects in broiler. Iraqi J Vet Sci. 2009;23(Suppl. 2):293-298.
15. Kamala A, Middha SK, Gopinath C, Sindhura HS, Karigar CS. In vitro antioxidant potentials of *Cyperus rotundus* L. rhizome extracts and their phytochemical analysis. Pharmacogn Mag. 2018;14(54):261-267. 10.4103/pm.pm_228_17
16. Sivapalan SR, Jeyadevan P. Physico-chemical and phytochemical study of rhizome of *Cyperus rotundus* Linn. Int J PharmacolPharmaceut Technol. 2017;1(2):42-46. 10.47893/IJPPT.2017.1022
17. Singh V, Ali M, Negi A, S Sultana. Analysis and antimicrobial activity of the essential oil of *Cyperus rotundus* L. rhizomes. J Med Plants Stud. 2018;6(5):101-105.
18. Sivapalan SR. Medicinal uses and pharmacological activities of *Cyperus rotundus* L. A Review. IJSRP. 2013;3(5):1-8.
19. Eltilib HH, Elgasim EA, Mohamed Ahmed IA. Effect of incorporation of *Cyperus rotundus* L. rhizome powder on quality attributes of minced beef meat. J Food Sci Technol. 2016;53(9):3446-3454. 10.1007/s13197-016-2317-6
20. Uddin SJ, Mondal K, Shilpi JA, Rahman MT. Antidiarrhoeal activity of *Cyperus rotundus*. Fitoterapia. 2006;77(2):134-136. 10.1016/j.fitote
21. Falowo AB, Fayemi PO, Muchenje V. Natural antioxidants against lipid-protein oxidative deterioration in meat and meat products: A review. Food Res Int. 2014;64:171-181. 10.1016/j.foodres.2014.06.022
22. Ahmad I, Mehmood Z, Mohammad F. Screening of some Indian medicinal plants for their antimicrobial properties. J Ethnopharmacol. 1998;62(2):183-193. 10.1016/S0378-8741(98)00055-5
23. Kaur S, Kumar S, Bhat ZF. Utilization of pomegranate seed powder and tomato powder in the development of fiber-enriched chicken nuggets. Nutr Food Sci. 2015;45(5):793-807. 10.1108/NFS-05-2015-0066
24. Sayre RN, Kiernat B, Briskey EJ. Processing characteristics of porcine muscle related to pH and temperature during rigor mortis development and to gross morphology 24 hr post-mortem. J Food Sci. 1964;29(2):175-181. 10.1111/j.1365-2621.1964.tb01714.x
25. Honikel KO, Hamm R. Measurement of water-holding capacity and juiciness. In: Pearson AM, Dutson TR, editors. Quality Attributes and their Measurement in Meat, Poultry and Fish Products. Advances in Meat Research. vol 9. Boston, MA: Springer;1994. p. 125-161. 10.1007/978-1-4615-2167-9_5
26. Rasmussen AL, Mast MG. Effect of feed withdrawal on composition and quality of broiler meat. Poult Sci. 1989;68(8):1109-1113. 10.3382/ps.0681109
27. Young L, Lyon C.E. Effect of electrical stimulation in combination with calcium chloride aor sodium chloride treatments at constant ionic strength on moisture binding and textural quality of early-harvested breast fillets. Poultry science, 1997, 76.10: 1446-1449.
28. Egan H, RS. Kirk, R Soyar. Pearson's chemical analysis of foods. Churchill Livingstone, Edinburgh, UK, 1981.
29. Witte VC, Krause GF, Bailey ME. A new extraction method for determining 2-thiobarbituric acid values of pork and beef during storage. J Food Sci. 1970;35(5):582-585.10.1111/j.1365-2621.1970.tb04815.x
30. Elmer, W. K., et al. A Color Atlas and Text Book of Diagnostic Microbiology. 1997. Printed in the united starter of America.
31. Guide SU. Statistic (Version 9.3). SAS Institute. Inc, Cary, NC, USA. 2010.
32. Anjum FM, Haider MF, Khan MI, Sohaib M, Arshad MS. Impact of extruded flaxseed meal supplemented diet on growth performance, oxidative stability and quality of broiler meat and meat products. Lipids Health Dis. 2013;12:13. 10.1186/1476-511X-12-13
33. Al-Rubeii AM, Hamodi SJ, Al-Hamdani HK. The Effects of using rosemary to improve quality characteristics and sensing of minced cold poultry meat.J. King Faisal University. 2008;9(2):1-18.
34. Mousa RK, Al Aboudi AA. Effect of using different types of *Origanummajarona*extracts on quality traits of thigh meat broiler in frozen storage. J Wasit Sci Med. 2017;10(2):72-82. 10.31185/jwsm.428
35. MF AQ, Al-Jumayli SMK, BSR Z. The Effect Of Using Hibiscus Extract To Maintain The Quality And Sensory Characteristics For Minced Frozen Spent Hen Meat. Iraq J of Market Research And Consumer Protection. 2012; 4(2):40-58.
36. Khamees AH, Abdulhussein AJ, Sahib HB, Fawzi HA. Anti-antigenic and antioxidant activity of Iraqi *Cyperus rotundus* ethanol extract. Int J Pharmacol. 2018;14:546-552. 10.3923/ijp.2018.546.552

37. Chandralekha S, Babu AJ, Moorthy PS, Karthikeyan B. Studies on the effect of pomegranate rind powder extract as natural antioxidant in chicken meat balls during refrigerated storage. J Adv Vet Res. 2012;2(2):107-112.
38. Modzelewska-Kapituła M. Effects of tomato powder on color, lipid oxidation and sensory properties of comminuted meat products. J Food Qual. 2012;35(5):323-330. 10.1111/j.1745-4557.2012.00457.x
39. Arora A, Nair MG, Strasburg GM. Structure-activity relationships for antioxidant activities of a series of flavonoids in a liposomal system. Free Radic Biol Med. 1998;24(9):1355-1363.10.1016/S0891-5849(97)00458-9
40. Madsen HL, Bertelsen G. Spices as antioxidants. Trends Food Sci Technol. 1995;6(8):271-277. 10.1016/S0924-2244(00)89129-7
41. Burt S. Essential oils: their antibacterial properties and potential applications in foods-a review. Int J Food Microbiol. 2004; 94(3):223-253. 10.1016/j.ijfoodmicro.2004.03.022
42. Taheri Y, Herrera-Bravo J, Huala L, Salazar LA, Sharifi-Rad J, Akram M, et al. Cyperus spp.: A review on phytochemical composition, biological activity, and health-promoting effects. Oxid Med Cell Longev. 2021;2021:4014867. 10.1155/2021/4014867
43. Melchini A, Costa C, Traka M. Chemical composition and bioavailability of glucosinolates and their precursors present in cruciferous vegetables. Phytochem Rev. 2009;8(1):213-229. 10.1007/s11101-008-9103-5
44. Bahorun T, Luximon-Ramma A, Crozier A, Aruoma OI. Total phenol, flavonoid, proanthocyanidin and vitamin C levels and antioxidant activities of Mauritian vegetables. J Sci Food Agric. 2004;84(12):1553-1561. 10.1002/jsfa.1873
45. Van Eylen D, Oey I, Hendrickx ME, Van Loey A. Kinetic analysis of thermal inactivation of peroxidase and lipoxygenase in a broad range of vegetables. J Agric Food Chem. 2008;56(12):4803-4810. 10.1021/jf073527g
46. Tarko T, Duda-Chodak A, Sroka P, Satora P, Michalik J. The effect of various sugar and polyol sweeteners on physicochemical properties of nonalcoholic beverages. Food Sci Biotechnol. 2016;25(2):353-361. 10.1007/s10068-016-0050-5
47. Custódio FB, Vasconcelos-Neto MC, Theodoro KH, Chisté RC, Gloria MB. Assessment of the quality of refrigerated and frozen pork by multivariate exploratory techniques. Meat science. 2018 May 1;139:7-14.
48. The Central Agency for Standardization and Quality Control. 1988. Draft Iraqi Standard No. (2688) for uncooked red meat and poultry products
49. Eltayeib AA, Ismaeel HU. Extraction of Cyperus rotundus rhizomes oil, identification of chemical constituents and evaluation of antimicrobial activity of the oil in North Kordofan state. Int J Adv Res Chem Sci. 2014;1(9):18-29.
50. Kilani-Jaziri S, Bhouri W, Skandrani I, Limem I, Chekir-Ghedira L, Ghedira K. Phytochemical, antimicrobial, antioxidant and antigenotoxic potentials of Cyperus rotundus extracts. South African Journal of Botany. 2011;77(3):767-776.
51. Daswani PG, Brijesh S, Tetali P, Birdi TJ. Studies on the activity of *Cyperus rotundus* Linn. tubers against infectious diarrhea. Indian J Pharmacol. 2011;43(3):340-344. 10.4103/0253-7613.81502
52. Erdem B, Bagci E, Dogan G, Aktoklu E, Dayangac A. Chemical composition and antimicrobial activities of essential oil and ethanol extract of *Cyperus fuscus* L burs from Turkey. Trop J Pharm Res 2018;17(8):1637-1643. 10.4314/tjpr.v17i8.24
53. Guessoum B, Seyd AH, Kemassi A, Rahim O. Evaluation of antibacterial activity of *Cyperus conglomeratus* (Cyperaceae). Phytothérapie. 2021;19(2):69-76. 10.3166/phyto-2019-0188
54. Zangana BS. The synbiotic effect of volaticle oil extracted from leaves *Rosmarinus officinolis* and *Nigellai sativa* on microbial and sensory characteristics of minced poultry meat during cold storage. Baghdad Sci J. 2016;13(3):402-412. 10.21123/bsj.2016.13.3.0402

تأثيراستخدام مسحوق المستخلص المائي لدرنات نبات السعد *Cyperus rotundus* على الخصائص النوعية واطالة مدةخزن ناجتس الدجاج

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الخلاصة

أجريت هذه التجربة لدراسة تأثير استخدام مسحوق المستخلص المائي لدرنات نبات السعد *Cyperus rutndus* لقطع ناجتس الدجاج في أكسدة الدهون والصفات الفيزيائية والميكروبية عند الخزن بالتجميد. اذ تم إضافة مسحوق المستخلص المائي لدرنات السعد بمستويات مختلفة ٠ ،٠,١ ،٠,٢ ،٠,٣ ،٠,٤٪ إلى لحم الدجاج المفروم، وبعده تم خزن جميع العينات لمدة ١ و ٣٠ يوم عند درجة حرارة -١٨°م. أدت إضافة مسحوق المستخلص المائي الى حصول زيادة معنوية في قيم الأس الهيدروجيني وقابلية الاحتفاظ بالماء لصالح المعاملات T2 وT3 وT4 وT5 بالمقارنة مع معاملة السيطرة T1 خلال الخزن. كما أظهرت النتائج انخفاضاً معنوياً في قيم مؤشرات الأكسدة (قيم البيروكسيد، حامض الثايوباربيوتريك، الاحماض الدهنية الحرة،النايتروجين الكلي المتطاير) للمعاملات T2، T3، T4 و T5 خلال فترة الخزن مقارنة بمعاملة السيطرة T1. كما لوحظ حصول انخفاض معنوي في العدد الكلي لبكتيريا القولون لقطع الناجتس لصالح المعاملات T2 و T3 و T4 و T5 مقارنة بمعاملة السيطرة T1 مع زيادة مستوى الاضافة للمستخلص المائي لدرنات السعد خلال فترة الخزن. نستنتج من الدراسة الحالية ان اضافة مسحوق المستخلص المائي لدرنات السعد له تأثير ايجابي في المحافظة على الخصائص النوعية وزيادة مدة حفظ قطع ناجتس الدجاج المخزون بالتجميد بدرجة -١٨°م ولمدة ٣٠ يوما.

الكلمات المفتاحية:نبات السعد، الناجتس، قابلية الاحتفاظ بالماء، قيم البيروكسيد، مضادات اكسدة طبيعية