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Review Article

Trials to Improve Quality of Marinated Poultry Meat by Using Chemical Food Additives

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Abstract

Poultry meat is included in food chains to use Part of this important commitment by using food additive Monosodium glutamate, replacement food additive monosodium glutamate with food additive sugar and food additive Sodium chloride on physical, chemical, bacteriological and sensory characters of deep fat of fried poultry meat at frozen storage for 90 days was examined. Poultry untreated samples moisture content, carbohydrate content and ash content than the poultry treated fried samples, moisture content, carbohydrate content and ash content for all treatments and slightly decreased as storage period increased. Food additive Monosodium glutamate is a sodium salt that is derived from an amino acid called glutamic acid. It's naturally occurring in our bodies and is in a whole bunch of other foods, the protein content and fat content of deep fat of fried poultry meat decreased by replacing food additive Monosodium glutamate with a mixture of 1:1 food additive sugar and food additive Sodium chloride. The crude protein content of all treatments slightly increased as storage period increased, while fat content of all treatments slightly decreased as storage period increased. The treatment mix of food additive sugar and food additive Sodium chloride in ratio of 1:1 as food additive Monosodium glutamate alternative had a higher, Water Holding Capacity, cooking loss, pH value and lower TVBN, and TBA values than food additive Monosodium glutamate (untreated). The untreated poultry meat had the highest of total bacterial contamination and lowest counts of total coliform bacteria, than other treatment. *E.coli* bacteria and Salmonella bacteria could not be detected in both treatments. Adverse reactions could only be possible in people who may have sensitivities and who have consumed food additive Monosodium glutamate. Since a typical serving of food with food additive Monosodium glutamate contains only 0.5 gm of food additive Monosodium glutamate, reactions are unlikely following typical meals, untreated poultry meat has the lowest counts of total Staph. Aureus bacteria, fungi microorganisms and total psychrophilic bacterial counts than other treatments. The treatment containing food additive Monosodium glutamate (untreated) had higher sensory characters than that treatment containing food additives mix of food additive sugar and food additive Sodium chloride as food additive Monosodium glutamate replacer.

Keywords: Food additive; Marinated meat; Frying; pH value; TVBN; TBA

Introduction

Poultry meat is a major component of the human healthy diet worldwide that is low in fat and cholesterol as compared to other meats as well as it is an excellent source of high-quality animal proteins, vitamins, and minerals [1]. In recent years, poultry meat products are considered one of the most products which attract the consumers because they represent quick, easily prepared meat meals with high health benefits and good flavor [2]. Rapid reproductive cycle, high acceptability of poultry meat due to its high biological value, palatability and many production processing variables; made poultry production one of the major worldwide food industry [3]. People have been using food additive Monosodium glutamate to season their food for over 100 years. Food additive Monosodium glutamate occurs naturally in food and in the body. Some manufacturers add it to food, such as fast food, to improve flavor. Food additive Monosodium glutamate is safe to eat. Links between food additive Monosodium glutamate and certain health concerns have used amounts of food additive Monosodium glutamate that a person is unlikely to consume as part of a meal. If a person does feel that they have a sensitivity to food additive Monosodium glutamate, they can stop eating it. Food allergies, Blood-thinning foods, drinks, and supplements. There are many things people can eat and drink that may help keep the blood thin and reduce the chances of developing dangerous clots. Several major manufacturers have announced to move away from using artificial ingredients and flavors in their products. Food additive Monosodium glutamate is one such ingredient that has been controversial for decades. It is one of the ingredients that some companies have committed to remove from products [4]. Food additive Monosodium glutamate is a flavor enhancer commonly added to processed food products like poultry to boost the palatability. Its remarkable effects on the sensory appeal have been proven in various studies [5,6]. Removal of food additive Monosodium glutamate is very likely to cause reduced consumer acceptability. Using food additive Monosodium glutamate substitute is a promising approach to compensate for the sensory satisfaction loss caused by food additive Monosodium glutamate elimination. The flavor enhancement effect of food additive Monosodium glutamate is mainly from glutamate which contributes to umami or savory taste sensation. Besides glutamate, there are several other umami eliciting components such as aspartate and 5'-ribonicleotides. Among nucleotides, inosinate (IMP) and guanylate (GMP) significantly contribute to flavor and taste enhancement [7]. Theoretically, substances that are naturally rich in umami components have the potential to replace food additive Monosodium glutamate in food

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products. Consumers preferred natural extracts such as yeast extract, mushroom extract, and tomato extract as Monosodium glutamate substitute in poultry products [8].

Food additives Sugars may also contribute to umami taste characters in the form of glutamate glycoconjugates [9]. Furthermore, salts of potassium are also responsible to enhance umami taste strength. However, during boiling process, significant levels of potassium leach out from potatoes [10,11]. Food additive Sodium chloride is an important ingredient added to most of foods which contributes to flavor enhancement and food preservation [12].

Food additive Monosodium glutamate is a flavor enhancer that is found in some processed foods and Chinese cuisine. To avoid this sodium product there are some potential substitutes can be used as substitutes for food additive Monosodium glutamate. Use 1:1 ratio mixture of food additive sugar sugar and food additive Sodium chloride as a substitute ingredient to your recipe instead of food additive Monosodium glutamate. This is safer to use, especially if you have children at home. Monosodium glutamate is a food additive used as a flavor enhancer. The advantage of food additive Monosodium glutamate goes to those who easily lose their appetite. This is a very common ingredient in fast foods and food seasonings. Food additive Monosodium glutamate is actually harmless but too much consumption would cause headaches and this is not good for people who have vertigo (a sensation of spinning) [13].

Currently, there is limited research comparing the enhancement effects of food additive Monosodium glutamate with these natural extracts in food products. Given the capability of salty taste enhancement, food additive Monosodium glutamate substitute may also be able to increase the sensory appeal of meat products with reduced Sodium chloride content. Previous study indicated that used of yeast extract successfully enhanced the taste of fermented sausage [14]. Ground mushroom has also been reported to improve the flavor of taco blend [15]. To replace food additive Monosodium glutamate, it is necessary to conduct more research to compare the performance between Monosodium glutamate and its alternatives in food additive Sodium chloride -reduced food matrix [16].

The present study aimed to investigated the influence of replacement food additive Monosodium glutamate with 1:1 ratio mixture of food additive sugar and food additive Sodium chloride on the characters of deep fat of fried poultry meat during frozen storage.

Materials and Methods

Materials

Poultry meat 74.33% moisture content 20.72% protein content, 2.26% fat content, 1.18% carbohydrate content, 1.18 Ash content and pH value 5.09, were obtained after 8 hours of slaughtering, transferred under cooling conditions to the Laboratory and saved at freezing for three months until processing.

Methods

Preparation of poultry meat: After preparation of poultry meat as described (Tables 1 and 2), samples divided into two groups: untreated group containing food additive (A) food additive Monosodium glutamate (C) and the other containing food additive Monosodium glutamate substitution (T).

Preparation of marinade solution: The water below 5°C was placed in a bag of high density polyethylene, after that the amount of food grade Sodium Tripolyphosphate (STPP) was dissolved in it, followed by dissolving the food additive Sodium chloride and food additive Monosodium glutamate in the case of untreated or food additive Monosodium glutamate substitution (a mixture of Sodium chloride and table sugar in a ratio of 1: 1) in the case of treatment and then add spices, antioxidant, and stirring to homogenize the marinade solution. The amount of raw poultry was added to previous brine after thawing it for 24 h in the refrigerator and reaching a temperature. The bags were closed and flipped for 5 minutes and placed in the refrigerator.

After one day, the bags were opened and the poultry meat was removed from the soaking solution and put on a stainless steel net for 5 min to drain excess brine solution, then the increase in the weight of poultry meat acquired from the marinade solution was calculated according to the following formula [17].

%marinade uptake = marinated weight - raw weight/raw weight. 100.

Deep-frying of marinade poultry meat: One and half liters of a mixture of sunflower and soybean oil 1:1 were placed in an electric fryer and the oil temperature was raised to 186°C:188°C, then the marinated and covered poultry meat was placed in the oil at a rate of 4 pieces each time and the weight of the piece was approximately 40 gm . When the temperature of the poultry meat reached 74°C to 76°C, they were removed from the oil and placed on a stainless steel mesh to get rid of the excess oil from the throwing process in the untreated sample. In the treatment sample (without Monosodium glutamate), the same previous steps were repeated after getting rid of the frying oil used in the untreated sample and replacing it with a new oil of the same type of oil. Samples were preserved by freezing until the completion of the tests [1,18].

Chemical examination: Chemical ingredients Moisture, ash, crude protein, and crude lipids (%) were determined according to the methods recommended by AOAC (2007) [19], while total carbohydrate content was measured by difference.

Bacteriological examination:

Preparation of samples for bacteriological examination: The Ten gm of each sample were homogenized with 90 mL of sterile saline

Table 1: Poultry meat.

Marinade formula		
Contents	Untreated (C)	Food additive Monosodium glutamate substitution (T)
Poultry meat	1800 gm	1800 gm
Potable water	360 gm	360 gm
Sodium Tripolyphosphate (STPP)	11.25 gm	11.25 gm
food additive Monosodium glutamate Purity more than 90%	11.25 gm	----------
food additive Monosodium glutamate substitution (S)	----------	11.25 gm
food additive Sodium chloride	15 gm	15 gm
Spices	22.95 gm	22.95 gm
TBHQ antioxidant	2.25 gm	2.25 gm
*Food additive Monosodium glutamate (T): mixtures consist of Sodium chloride and sugar by ratio of 1:1.		
Spices (onion powder 9 gm, garlic powder 9 gm, Celery powder 2.25 gm, Ginger powder 2.7 gm.		

Table 2: Coated poultry meat.

Coating formula		
Ingredients	Untreated (C)	Food additive Monosodium glutamate (T)
Product		
Wheat flour	1000 gm	1000 gm
Corn starch	259.74 gm	259.74 gm
Sodium chloride	38.96 gm	38.96 gm
Batter		
Wheat flour	400 gm	400 gm
Sodium chloride	7.90 gm	7.90 gm
Food additive Monosodium glutamate purity more than 90%	17.28 gm	----------
*Food additive Monosodium glutamate substitution (T)	----------	17.28 gm
Corn starch	49.38 gm	49.38 gm
Spices**	6.89 gm	6.89 gm
*Food additive Monosodium glutamate (S) mixture consist of food additive (C) and food additive (B) by ratio of 1:1		
** Batter spices consist of (garlic powder 2.46 gm, ginger powder 1.97 gm and black pepper powder 2.46 gm		
Breading		
Wheat flour	1000 gm	1000 gm
Corn starch	200 gm	200 gm
Sodium chloride	25.4 gm	25.4 gm
Sodium bicarbonate	14 gm	14 gm

solution (9 g NaCl/L distilled water). The suspension was shocked by shaker for 5 min to give 0.1 dilutions. Then different dilutions (1:10-1 to 1:10-6) were prepared to be used for microbiological examination.

The bacterial count: The bacterial count was carried out as the methods recommended by APHA [20] and Shaltout et al. [21].

Fungi: Medium of Potato dextrose agar was used for yeast and mold count. Plates were incubated at 25°C for 5 days, according to APHA [20], and Shaltout et al. [21].

Total Coliform bacteria count: Violet red bile agar medium was used for counting of coliforms bacteria. Plates were incubated at 37°C for 24 hours, according to the method recommended by APHA [20].

Staphylococcus aureus bacteria: Staphylococcus aureus bacteria was performed as the methods described in ISO, 4833-1 [22] and Shaltout [21].

Salmonella spp bacteria: Salmonella spp test was performed as the methods described in ISO, 6579 [23] and Shaltout et al. [24].

Freshness examination:

pH Value (ES 63/11, 2006) [25]: By using a stomacher, approximately ten gm of poultry meat sample under examination were homogenized with 25 mL of neutral distilled water, and left to stand for 10 min at room temperature with continuous shaking and filtered. The pH value was detected by using electrical pH meter (ACTWA-AD1200-1034678) calibration of pH meter by using two buffer solutions of exactly known pH value (alkaline pH value 7.01, acidic pH value 4.01). So, pH meter electrode was washed with neutralized water, then introduced into the homogenate.

Determination of Total Volatile Basic Nitrogen (TVB/N)"mg" % (E.S. 63/10, 2006) [26]: Ten gm of sample were minced in a stomacher for 1 min-2 min until homogenization. Then in a distillation flask add two gm of magnesium oxide and 300 mL distilled water to the minced sample. Make distillation and receive 100 mL distillate within 30 minutes in a beaker contain 25 mL of 2% boric acid. Then titrate against H2SO4 0.1 M until faint pink color.

TVN mg/100g = R × 14

Where R is the volume of H2SO4 exhausted in titration.

Determination of Thiobarbituric Acid (TBA)"mg/Kg" (E.S. 63/9, 2006) and Shaltout [27]: For detection of TBA number which is expressed as milligm of malondialdehyde equivalents per kilogm of sample. Ten gm of sample were blended with 48 mLof distilled water, to which two mL of 4% of ammonium chloride (to bring's the pH value to 1.5) were added in astomacher for two minutes and left at room temperature for ten minutes . The mixture was quantitatively transferred into Kjeldahl flasks by washing with additional 50 mL distilled water, followed by an anti-foaming preparation and few glass beads. The Kjeldahl distillation apparatus were assembled and the flask was heated to 50°C. 50 mL distillate were collected in ten minutes from the time of boiling commences. The distillate was mixed, then 5 ml was pipette into a glass- stoppard tube. Five ml of TBA reagent (0.2883 gm/100 mL of 90% glacial acetic acid) were added. The tube was stoppered, shacked then immersed in boiling water bath for 35 min. A blank was similarly prepared using 5 ml distilled water with 5 ml TBA reagent and treated like the sample. After heating, the tube was cooled under tape water for ten minutes. A portion was transferred to a curette and the Optical Density (D) of the sample was read against the blank by means of spectrophotometer (Perkin Elmer, 2380, USA) at a wave length of 538 nm.

TBA value (mg malondialdehyde/kg of sample) = D × 7.8. D: the read of sample against blank.

Physical examination:

Water holding capacity and plasticity: The water holding capacity and plasticity were measured according to the method described by Soloviev [28]. A weight of 0.3 gm of ground meat was placed under ash less filter paper (Whatman, No. 41) between tow glass plates (20 cm × 20 cm) and pressed for 10 min, using 1 Kg weight. Two zones were measured using the planimeter, the water holding capacity was calculating by subtracting, the area of the internal zone from that of the outer zone. The internal zone represented the plasticity. Results were presented in 2 cm per 0.3 gm of raw sample.

Cooking loss: The samples weighing 25 g to 30 g (W1) were packed in plastic tubes. The tubes were then heated at 95°C, until the internal temperature of the samples reaches 75°C. The temperature was detected by using thermocouples inserted into the center of the sample. The samples were considered cooked when the internal

temperature reached 75°C after cooking, the meat was weighed again (W2) to determine the loss in weight during cooking as recorded by Mamaghani [29] and Shaltout [1].

Cooking loss (%)=(W1-W2/W1) × 100

Sensory examination: Ten experienced panelists peoples made a sensory characters of full fried poultry meat, each panelist was invited to give a numerical value from 0 to 10. Scores extended from one to ten which illustrate dislike extremely to the like extremely, texture, color, odor and crispness [30] and Shaltout [1].

Statistical analysis: The data of this study were Analyses for Variance (AVOVA) by using software (SAS institute, 1998) [31]. Differences between means were collected by the Least Significant Differences (LSD) at $p<0.05$. All examinations were carried out in triplicate.

Results and Discussion

Physical, chemical and bacteriological characters of poultry meat

The chemical constituents of raw poultry meat is presented in (Table 3). Moisture content, protein content, fat content, carbohydrate content and ash content of raw poultry meat was (73.66, 20.72, 2.4, 1.18 and 1.18 g/100 gm, respectively as the data obtained by Petracci et al. [32] and Shaltout [1], who found that moisture content, protein content, fat content and ash content of raw poultry meat were 75.10, 22.90, 0.78, and 1.30 g/100 gm, respectively.

The total volatile based nitrogen (mg/100 gm) and thiobarbituric acid milligm of malonaldehyde mg/kg of raw poultry meat was (11.34 mg/100 g and 0.24 (MA)/kg), respectively as recorded by Hassan et al. [33] and Kim et al. [34]

Results presented in Table 3 revealed that the color values (L*, a*, and b*) of poultry was 55.6, 3.2 and 11.5 respectively. While water holding capacity and pH values of raw poultry was 44.2 and 5.09 respectively as mentioned by Qiao et al. [35], Kaewthong et al. [36] and Shaltout [1].

Aerobic bacteria, coliform bacteria, *E. coli* bacteria, *salmonella bacteria, staph positive coagulase bacteria, psychrophilic bacteria* and yeast and mold counts of poultry meat was recorded in (Table 4). Total aerobic bacterial, *coliform bacteria, salmonella bacteria, staph. aureus, psychrophilic bacteria* and fungal counts were 2.6×10^5, 0.72×10^2, ND, ND, 0.67×10^2, 3.3×10^6 and 6.4×10^1 respectively as those mentioned by Eglezo et al. [37], Al-Nehlawi et al. [38], Rougeret al. [39] and Shaltout et al. [21].

Table 3: Physical, chemical and microbial status of poultry meat.

Constituents	Poultry meat
Moisture content	73.66 ± 4.25
Protein content	20.72 ± 2.34
Fat content	2.4 ± 0.14
Carbohydrate content	1.18 ± 0.08
Ash content	1.18 ± 0.06
Total volatile based nitrogen (mg/100g)	11.34 ± 1.24
Thiobarbituric Acid (TBA) mg MA/kg	0.24 ± 0.08
Color	L* 55.62 ± 3.12
	a* 3.22 ± 0.14
	B* 11.57 ± 1.22
Water Holding Capacity (WHC)	44.20 ± 2.00
pH	5.09 ± 0.18
Total aerobic bacterial (cfu/gram) bacteria	2.6×10^5
Total coliform (cfu/gram) bacteria	0.72×10^2
E.coli (cfu/gm) bacteria	ND
Salmonella detection (cfu/g) bacteria	ND
Staph. Aureus (cfu/gm) bacteria	0.67×10^2
Psychrophilic bacteria (cfu/g) bacteria	3.3×10^6
Yeast & Mold (cfu/g) fungi	6.4×10^1

Chemical examination of deep fat of fried poultry meat during frozen storage

Poultry meat under examination chemically examined to detect the gross chemical composition and physical characters. It could be noticed that moisture loss of deep fat of fried poultry meat significantly decreased as a function of storage time for both samples. The control (untreated) samples had statistically higher moisture content than the treated fried samples. This could be due to water loss during frying. All coatings provided a beneficial barrier for moisture and preserved samples from moisture loss during storage. The lower water loss for the coated deep fat of fried poultry meat may be due to controlling the loss of water and reducing dehydration as those reported by Hwang et al. [40], Prejsnaret al. [41] and Shaltout [1].

The crude protein content of deep fat of fried poultry meat decreased by replacing food additive Monosodium glutamate with a mixture of 1:1 sugar and Sodium chloride this may be due to containing of food additive Monosodium glutamate on amino acids. The crude protein content of all treatments slightly increased as storage period increased. Freezing storage has been shown to induce protein carboxylation, and the formation of Schiff bases in poultry meat [42]. Freezing storage has impacts on the activities of endogenous proteolytic enzymes cause degradation of meat protein as well as the relaxation of poultry meat structures [43]. Study conducted by Smiecinska et al. [44] mentioned that the increased content of total and soluble protein content in poultry meat after 6 weeks of freezing storage as observed by Hwang et al. [40], and Prejsnar et al. [41].

Fat content of poultry meat did not affected by replacing. Untreated samples had the highest fat content than treated samples. The fat content of all treatments slightly decreased as storage period increased. This decrease of fat content may be explained by the autolysis of lipid [1,45].

Carbohydrate conrent and ash content were higher in sample containing food additive sugar and food additive Sodium chloride mixture as alternative for food additive Monosodium glutamate. The observed reduction in ash content was probably due to increased meat leakage during the fried process, hence the subsequent increased loss of mineral salts. Chwastowska and Kondratowicz [46] also demonstrated the effect of thawing (in atmospheric air and microwave) methods on the ash content of meat.

Physical and chemical examinations of deep fat of fried poultry meat during frozen storage

From data presented in Table 5, the pH value of deep fat of fried poultry meat during frozen storage of both treatments increased as storage period increased. Treatment contains mix of food additive sugar and food additive Sodium chloride in ratio of 1:1 as MSD alternative had the higher pH values than treatment containing food additive Monosodium glutamate (untreated sample). These results are in agreement with those obtained by Hwang et al. [40] and Prejsnar et al. [41]. The slight increase in pH value during storage may be due to inhibition of bacterial growth during frozen storage as Bouacida et al. [47].

The TVBN of both treatments increased as storage period

Table 4: Replacing of food additive monosodium glutamate with mix of food additive sugar and food additive sodium chloride in ratio of 1:1 on chemical composition of deep fat of fried poultry meat during frozen storage.

Items		Storage Period (day)			
		0	30	60	90
Moisture	C	57.97 ± 1.12[a]	57.61 ± 1.20[a]	55.57 ± 1.24[a]	53.53 ± 1.08[a]
	T	58.35 ± 1.08[b]	58.06 ± 1.18[b]	55.65 ± 1.22[b]	55.24 ± 1.14[b]
Protein content	C	15.24 ± 0.50[a]	15.46 ± 0.45[a]	15.58 ± 0.52[a]	15.52 ± 0.52[a]
	T	13.64 ± 0.52[b]	13.73 ± 0.48[b]	13.85 ± 0.55[b]	13.97 ± 0.48[b]
Fat	C	10.07 ± 0.16[a]	9.63 ± 0.20[a]	9.11 ± 0.26[a]	8.60 ± 0.18[a]
	T	9.04 ± 0.14[b]	8.23 ± 0.24[b]	7.77 ± 0.28[b]	7.32 ± 0.20[b]
Carbohydrate	C	14.78 ± 0.66[a]	14.36 ± 0.64[a]	14.08 ± 0.68[a]	13.80 ± 0.58[a]
	T	15.87 ± 0.68[b]	14.15 ± 0.60[a]	13.87 ± 0.70[a]	13.60 ± 0.62[a]
Ash	C	1.93 ± 0.06[a]	1.26 ± 0.09[a]	1.21 ± 0.18[a]	1.17 ± 0.08[a]
	T	2.06 ± 0.08[b]	2.00 ± 0.07[b]	1.98 ± 0.12[b]	1.96 ± 0.06[b]

Table 5: Replacing food additive Monosodium glutamate with mix of food additive sugar and food additive Sodium chloride in ratio of 1:1 on physical and chemical quality of deep fat of fried poultry meat during frozen storage.

Items		Storage period (day)			
		0	30	60	90
pH	C	5.4 ± 0.16[b]	6.4 ± 0.18[b]	6.5 ± 0.20[b]	6.6 ± 0.16[b]
	T	5.7 ± 0.12[a]	6.7 ± 0.14[a]	6.8 ± 0.18[a]	6.9 ± 0.18[a]
Total volatile based nitrogen (mg/100g)	C	7.0 ± 0.14[a]	13.14 ± 1.06[a]	14.78 ± 1.00[a]	16.6 ± 1.02[a]
	T	5.6 ± 0.16[b]	12.50 ± 1.00[b]	14.05 ± 1.08[b]	15.60 ± 1.06[b]
Thiobarbituric Acid (TBA) mg MA/kg	C	0.45 ± 0.01[a]	2.10 ± 0.02[a]	2.22 ± 0.04[a]	2.34 ± 0.03[a]
	T	0.41 ± 0.02[b]	1.0 ± 0.03[b]	1.05 ± 0.02[b]	1.11 ± 0.04[b]
WHC Water holding capacity	C	21.94 ± 1.16[a]	21.82 ± 1.12[a]	21.76 ± 1.18[a]	21.70 ± 1.16[a]
	T	21.98 ± 1.12[a]	21.90 ± 1.10[a]	21.86 ± 1.14[a]	21.83 ± 1.18[a]

increased. Treatment containing mix of sugar and Sodium chloride in ratio of 1:1 as MSD alternative had the lower TVBN values than treatment containing food additive Monosodium glutamate (untreated sample). The increasing in TVBN value due to the breakdown of nitrogenous substances by microbial activity as reported by Edris et al. [48], Prejsnar et al. [41] and Shaltout [1].

On the other hand, the TBA values of both treatments increased as storage period increased. Treatment contains mix of food additive sugar and Sodium chloride in ratio of 1:1 as MSD alternative had the lower TBA values than treatment containing food additive Monosodium glutamate (untreated sample). These results are in agreement with those obtained by Hwang et al. [40] and Prejsnar et al. [41]. The increasing of TBA value taken place due to lipid oxidation as reported by El-Gharably and Ashoush [49]. However, a high degree of poly unsaturation accelerates oxidative processes leading to deterioration in meat flavor, color, texture and nutritional value [50].

Water holding capacity of deep fat of fried poultry meat during frozen storage of both treatments decreased as storage period increased. Treatment contains mix of food additive sugar and food additive Sodium chloride in ratio of 1:1 as food additives Monosodium glutamate alternative had the higher WHC values than treatment containing food additives Monosodium glutamate (untreated sample). These results are in agreement with those obtained by Prejsnaret al. [41], Bouacida et al. [51] and Shaltout [1].

The cooking loss of deep fat of fried poultry meat increased significantly as storage period increased for all samples. Treatments containing Monosodium glutamate had the higher cooking loss percentage values than untreated sample as obtained by Aksu and Alp [52], Smaoui et al. [53], Kruk et al. [54] Hwang et al. [40], Smaouiet al. [53] and Prejsnaret al. [41].

Microbiological examination of deep fat of fried Poultry meat during frozen storage

The microbiology examinations of deep fat of fried poultry meat during frozen storage were examined to determine some microbiological quality and shelf life validity throughout frozen storage. Microbial growth in meat and meat products can result in slime formation, structural components degradation, decrease in water holding capacity, off odors, and texture and appearance changes which reduce their quality, nutritional value and reduce the shelf life [1,55].

Bacterial count

Table 6 shows that there were significant differences in viable bacterial count between the untreated poultry meat and other poultry meat sample. The results indicated that total bacterial count decreased gradually throughout the storage period until the end of storage period. The obtained results also showed that untreated poultry meat had the highest counts of total bacterial count than other treatment. This might due to the antimicrobial activity of Sodium chloride or sugar [56]. Similar results were reported by Aksu and Alp [52], Malay et al. [57], Hwang et al. [40], Prejsnaret al. [41] and Bouacida et al, [51].

Table 6: Replacing food additive monosodium glutamate with mix of food additive sugar and food additive sodium chloride in ratio of 1:1 on microbial quality of deep fat of fried poultry meat during frozen storage.

Viable count(cfu/g)		Storage period (day)			
		0	30	60	90
T B C Total Bacterial count	C	2.95×10^1	<10	<10	<10
	T	4.59×10^1	<10	<10	<10
T C C Total coliform count	C	0.51×10^1	<10	<10	<10
	T	0.80×10^1	0.59×10^1	0.42×10^1	<10
E. coli	C	ND	ND	ND	ND
	T	ND	ND	ND	ND
Salmonella detection	C	ND	ND	ND	ND
	T	ND	ND	ND	ND
Staph aureus bacteria	C	0.57×10^1	<10	<10	<10
	T	0.72×10^1	0.50×10^1	0.30×10^1	<10
Psychrophilic bacteria	C	3.74×10^2	1.34×10^4	1.14×10^4	0.51×10^4
	T	3.69×10^3	2.52×10^4	2.46×10^4	2.40×10^4
fingi	C	2.51×10^1	<10	<10	<10
	T	6.13×10^1	<10	<10	<10

Coliform bacteria

Table 6 shows the differences in coliform counts. The results indicated that total coliform count decreased gradually throughout the storage period until the end of storage period. The obtained results also showed that untreated poultry meat had the lowest counts of total coliform count than other treatment. Similar results were reported by Hwang et al. [40], Smaoui et al. [53] Prejsnaret al. [41], Shaltout et al. [21] and Bouacida et al. [51].

E. coli count

The results presented in Table 6 indicated that total *E. coli* count did not detect in both treatments until the end of storage period as reported by Hwang et al. [40], Smaoui et al. [53], Prejsnaret al. [41], Shaltout et al. [21] and Bouacida et al. [51]

Salmonella count

The results presented in Table 6 indicated that Salmonella did not detect in both treatments until the end of storage period as reported by Hwang et al. [40], Smaoui et al. [53], Prejsnaret al. [41], Shaltout et al. [24] and Bouacida et al. [51].

Staph Aureus bacteria

Table 6 shows the differences in Staph coagulase bacteria counts. The results indicated that total *Staph aureus* bacteria count decreased gradually throughout the storage period until the end of storage period. The obtained results also showed that untreated poultry meat had the lowest counts of total Staph coagulase bacteria count than other treatments as reported by Hwang et al. [40], Smaouiet al. [53], Prejsnaret al. [41] and Bouacida et al. [51].

Psychrophilic bacteria

Table 6 shows the differences in psychrophilic bacteria counts. The results indicated that total psychrophilic bacteria count increased gradually throughout the storage period until the end of storage period. The obtained results also showed that untreated poultry meat had the lowest counts of total psychrophilic bacteria than other treatment as reported by Hwang et al. [40], Smaouiet al. [53], Prejsnaret al. [41], Bouacida et al. [51] and Shaltout [17].

Fungal count

The differences in yeast and mold counts of deep fat of fried poultry meat during frozen storage as revealed in Table 6. The results indicated that total yeast and mold count decreased gradually as the storage period increased until the end of storage period. The obtained results also showed that untreated poultry meat had the lowest counts of total yeast and mold than other treatment as reported by Hwang et al. [40], Hassan et al. [33], Smaoui et al. [53], Prejsnar et al. [41] and Bouacida et al. [51].

Sensory examination of deep fat of fried poultry meat during frozen storage:

Poultry meat is a nutritious food and it is consumed all over the world because of its relatively low cost and low fat content. However, it is highly perishable with a relatively short shelf life even when it is kept under refrigeration. Thus, developing more appropriate technologies for its preservation could be highly useful, in order to increase the shelf life of meat products [58] and Edris et al. [48].

Statistical analysis showes a significant difference in sensory characters between both samples. Treatment containing food additive Monosodium glutamate (untreated) had the higher sensory proprieties (color, taste, crispness, odor and acceptability) than that treatment containing mix of sugar and Sodium chloride as Monosodium glutamate replacer [59-61] (Table 7).

Table 7: The effect of replacing food additive monosodium glutamate with mix of food additive sugar and food additive sodium chloride in ratio of 1:1 on sensory characters of deep fat of fried poultry meat during frozen storage.

Parameters		Value
Color (10)	C	8.41 ± 0.16^{a}
	T	8.08 ± 0.18^{b}
Taste (10)	C	8.0 ± 0.22^{a}
	T	7.83 ± 0.26^{b}
Crispness (10)	C	8.08 ± 0.14^{a}
	T	7.66 ± 0.22^{b}
Odor (10)	C	8.0 ± 0.26^{a}
	T	7.25 ± 0.20^{b}
Acceptability	C	8.12 ± 0.30^{a}
	T	7.85 ± 0.34^{b}

Values (means ± SD) with different superscript letters are statistically significantly different ($p \leq 0.05$).

The overall acceptability of deep fat of fried poultry meat during frozen storage (-18°C ± 1°C) were significantly higher in (C), while it was significantly lower in the sample treated with mix of sugar and Sodium chloride as Monosodium glutamate replacer. Statistical analysis appears a significant difference in overall acceptability between both samples as reported by Al-Dughaym and Altabari [59], Smaoui et al. [53], Kruk et al. [54], Hwang et al. [40], Edris et al. [48], Prejsnaret al. [41] and Bouacida et al. [51].

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