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PROLONG THE SHELF–LIFE OF CHILLED KOFTA USING EXTRACT OF GREEN TEA LEAVES

(With 4 Tables)

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إطالة فترة الصلاحية للكفتة المبردة باستخدام مستخلص أوراق الشاي الأخضر

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تم دراسة تأثير إضافة تركيزات مختلفة من مستخلص الشاي الأخضر إلي اللحم البقري الطازج المفروم والمجهز لعمل المنتج المصري المعرف بأسم الكفتة وذلك علي الجودة الحسية والبكتريولوجية والكيميائية. وتم تقسيم العينات إلي خمس مجموعات وخلط كل مجموعة بمستخلص الشاي الأخضر بتركيز صفر% (المجموعة الضابطة) ٠,٥% ،١%، ١,٥%، ٢% علي التوالي ثم حفظها عند درجة حرارة ٤ درجة مئوية حيث تم الفحص خلال فترات من ٠ ، ٢ ، ٤ ، ٦ ، ٨ يوماً. وأظهرت النتائج أن معالجة العينات بتركيز ١% ، ١,٥% ، ٢% من مستخلص الشاي الأخضر أعطي نتيجة ايجابية وتحسين المظهر العام والرائحة ولون المنتج لمدة تصل إلي ٨ أيام من التخزين. وكان العدد الكلي للبكتريا المحبة للبرودة في العينات المعالجة حتى اليوم الثامن من التخزين أقل من 10^6 خلية لكل جرام بينما فسدت عينات المجموعة الضابطة بعد ٦ أيام تخزين. كما أظهرت الدراسة أن مستخلص الشاي الأخضر له تأثير خافض بشكل عام علي الأحمال البكتيرية لكل من العدد الكلي لميكروب كلوستريديم برفرنجيز والعدد الكلي لبكتريا الأمعائية والعدد الكلي للمكورات العنقودية الذهبية. وأظهرت النتائج انخفاضا في قيمة الرقم الهيدروجيني وقيم حامض الثايوباربتيورك في كل العينات المعالجة مقارنة بالمجموعة الضابطة. هذا وقد أوصت الدراسة بإمكانية استخدام الشاي الأخضر في حفظ منتج الكفتة المصرية حتى ٨ أيام كبديل طبيعي للمواد الحافظة الكيميائية ولتحسين الجودة وإطالة فترة التخزين عند حفظها عند درجة حرارة أربعة درجات مئوية.

SUMMARY

The effects of various concentrations of green tea, *Camellia sinensis,* extract on the sensory, bacteriological and chemical quality of Egyptian traditional Kofta were studied. For this purpose, kofta samples were divided into five groups. First group was kept as a control, others groups were treated with 0.5%; 1.0%; 1.5% and 2.0% green tea extract (GTE). All samples were stored at 4° C whereas sensory, bacteriological and chemical evaluation of the samples were conducted at 0; 2; 4; 6 and 8

days post–storage. Flavour and taste were accepted by panelists with high score in samples treated with concentrations between 1and 1.5% GTE. There were marked discoloration changes of kofta samples treated with 2.0% GTE. Total psychrophiles counts reached the unacceptable count (5×10^6) at 6th day in 0% control samples while reached 8×10^5; 4×10^5; 7×10^5 and 8×10^4 at 8th day in each treated samples with 0.5%; 1.0%; 1.5% and 2.0% GTE respectively. Green tea extract showed an inhibitory effect on *C. perfringens*, *Enterobacteriaceae* and *Staphylococcus aureus* counts with increased storage time in compared to control samples. Also, beef kofta samples treated with green tea extract showed lower pH and thiobarbituric acid reactive substance values all over the storage period compared to control. These results suggest that green tea extract treatment could be effectively used to extend the shelf–life of fresh kofta for up to 8 days when stored at 4°C.

Key words: *Green tea leaves, meat products, kofta.*

INTRODUCTION

Egyptian traditional kofta is one of the comminuted meat products and its popularity in all classes of Egyptian society has attracted interest of the meat processors as a business opportunity. The changes in consumer attitudes toward the use of synthetic antimicrobial compounds for prolong their shelf-life and to ensure safety of meat products have been challenge food investigators to seek of naturally compounds those poses antimicrobial properties in foods.

Green tea, *Camellia sinensis*, extract (GTE) is a highly safe way preserving its value for use in meat, it has antioxidant, deodorant and antimicrobial functions. It is a natural preservative that prolong the shelf-life of foods, enhance quality and provide safer products (Diker *et al.*, 1991; Ji- sun and Yangh, 2007).

Several studies have been revealed to the antimicrobial properties of green tea extract (Ahn *et al.*, 1991; Sakanka *et al.*, 2000; Noriyuki *et al.*, 2001; Kim *et al.*, 2004; Juneja *et al.*, 2007). The extract of green tea leaves has organic compounds including polyphenolic and catchin compounds which has effect against some foodborne pathogens as *E. coli*, *Clostridium perfringens*, *Staph. aureas* and *Salmonella enteritidis* (Kuroda and Hara, 1999; Noriyuki *et al.*, 2001; Friedman, 2007). Catechins can reduce the potential risk of *Cl. perfringens* during abusive cooling for beef and chicken. It has more inhibition effect on the

extracellular release of verotoxin from enterohemorrhagic *Escherichia coli* (Sakanaka *et al.*, 2000; Juneja *et al.*, 2007).

The natural antioxidants as green tea extract decrease malonaldhyde formation which minimize the oxidize ability of fatty acids by chelating iron and copper which cause the disruption of metal-catalyzed free radical formation. It inhibits the formation of lipolytic and proteolytic degradation products and improve the sensorial and physical quality of the treated food (Chander *et al.*, 2005; Hüseyin, 2006; Kumudavally *et al.*, 2008; Dembele *et al.*, 2010). Green tea extract as food additives improved the shelf-life of fresh mutton at ambient storage condition (25± 2 °C and 85± 5% RH) and significantly inhibited spoilage microflora, including certain pathogens for up to 4 days, meanwhile control samples showed initial signs of spoilage between 20 and 24 hours (Kumudavally *et al.*, 2008).

Therefore, this study was planned to evaluate the effect of different concentrations of green tea extract as food additives on the sensory, microbial and chemical quality of the traditional Egyptian meat product "Kofta" and their effect on extending the shelf-life of the product under chilling storage.

MATERIALS and METHODS

Egyptian traditional kofta are produced from a mixture of finely ground meat with cooking salt, onion, and garlic. This mixture is formed into balls ranging in size from a marble to a ping-pong ball and then cooked in griller.

Preparation of Green Tea extract:

One hundred gram of the grounded leaves was extracted by using technique of James *et al.* (2010). 500 ml of distilled water were poured in sterile conical flask then covered with aluminum foil and kept at room temperature for 48 hours. After which the extract was obtained by filtering using a filter paper. The extract was concentrated by drying in a water bath maintained at a temperature of 40°C until brownish black residues were obtained and these were kept in sealed containers and refrigerated at 3± 1° C until required.

Experimental design:

Fresh beef was purchased from local market at Ismailia city (Egypt) on the day of preparation. Beef was cut and minced with a grinder through a 4 mm plate diameter. Beef was divided into five groups, each group included 25 samples (each 150g). The five groups

were thoroughly mixed in sterile mixer with 0% (control group), 0.5%, 1%, 1.5% and 2% green tea extract (GTE) eventually. Each sample was made as traditional Egyptian meat product named "Kofta" then wrapped with saran wrap and placed in a chiller at 4°C ± 1 for 0, 2, 4, 6 and 8 day. Five samples were periodically removed for sensory, bacteriological and chemical evaluation as follows:

1- Sensory evaluation:

The procedure recommended by ASTM (1969) was used for sensory evaluation. Panelists were asked to sign a consent form. Kofta samples were grilled on electric grill for 20 minutes then acceptance testing was used to determine how much each sample was liked based on 5 points according to the guidelines cited below for a set taste, flavour and colour, where 5 = like excellent and 1 dislike poor.

Score	Quality Items for Kofta Samples
5	Natural flavour, color and odour
4	No sensible change in natural flavor, color, and odour
3	Sensible discoloration. Slightly sour odour and incipient rancidity in flavour
2	No natural color, moderately off-odor and off- flavor
1	Sharply sour and extremely rancid flavour, extremely discolored.

Sensory Schema (ASTM, 1969).

2- Bacteriological evaluation:

The technique recommended by APHA (2001) was used for preparation of Kofta samples. 25g of the sample were aseptically removed and homogenized in 225 ml of 1% sterile buffered peptone water for 2 min using a stomacher 400 lab Blender to provide dilution of 10^{-1}. From the original homogenate, 1 ml was aseptically transferred to a test tube containing 9 ml sterile buffered peptone water (1%), from which 10 fold serial dilutions up to 10^{-8} were prepared. By using surface plate technique, 0.1 ml from each of the previously prepared dilution was plated as follows: on each duplicate Standard Plate Count Agar for total psychrophiles count (AOAC, 1990), on Lactose Sulphite Broth for *C. perfringens* (MPN/g) (Beerens *et al.*, 1980), on Violet Red Bile Glucose Agar for total Enterobacteriaceae counts and on Baird Parker Agar with Egg Yolk-Tellurite Emulsion for *Staphylococcus aureus* count (APHA, 2001).

3- Chemical evaluation:

a- Determination of pH: According to the method reported by Benjakul *et al.* (1997) using pH meter (*PH-Meter 761 Calimatic West Germany*)

b- Determination of Thiobarbituric Acid Reactive substance (TBARS):

TBARS value was determined by the technique recommended by Vyncke (1970). The absorbance was measured against the blank at 538nm. TBARS value was expressed as mg malonaldehyde/kg samples.

RESULTS

Table 1: Mean values of sensory evaluation of treated beef kofta samples after grilled at the first day.

GTE	Taste	Flavor
0.0%	3.8	3.9
0.5	4.11	4.2
1%	4.60	4.2
1.5%	4.3	4.1
2%	4.0	4.0

Score = 5 (natural): 1 (no natural)
GTE = Green Tea Extract

Table 2: Mean values of sensory evaluation of treated beef kofta samples during storage at 4C°

Storage (day)	Control			0.5% GTE			1% GTE			1.5% GTE			2% GTE		
	A	F	C	A	F	C	A	F	C	A	F	C	A	F	C
Zero	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2	3.7	3.9	3.5	4	4	4	4	4	4. 3	4.5	4.5	4.2	4.5	4.5	4
4	3	3	3	3.5	3.5	3.5	4	4	4	4	4	4	4	4	3.5
6	2	2	2.5	3.5	3.2	3.5	3.8	3.9	3.7	4	3.9	3.5	3.5	3.8	3.5
8	*S	*S	*S	2.8	2.7	2.5	3.5	3.5	3.5	3.7	3.8	3	3.5	3.5	3

A= General appearance F= flavour C = colour
Score: 5 (natural) 1 (no natural)
GTE = Green tea Extract
* S = Spoiled

Table 3: Effect of different concentrations of green tea extract on bacterial quality of beef kofta stored at 4 C° (CFU/g).

Time /Day		T. Ps.C		*C. perferingens* MPN/g		Enterobacteriaceae		*Staph. aureus*	
		Mean	S.E.±	Mean	S.E.±	Mean	S.E.±	Mean	S.E.±
Control	0	$9X10^3$	$3X10^2$	4	1.3	$3X10^3$	$3X10^2$	$6X10^3$	$2X10^2$
	2	$3X10^4$	$2X10^3$	7	2.3	$8X10^3$	$5X10^2$	$9X10^3$	10^3
	4	$8X10^5$	$6X10^2$	ND	-	$6X10^4$	$3X10^3$	$2X10^4$	$6X10^3$
	6	$5X10^6$	$4X10^4$	ND	-	$8X10^4$	$2X10^4$	$1X10^5$	$2X10^4$
	8	*S		*S		*S		*S	
0.5%	0	$6x10^3$	$3x10^3$	4	1.4	$1X10^3$	10^2	$9X10^2$	10^2
	2	$3x10^4$	$2x10^2$	7	2.3	$4X10^3$	$2X10^2$	$3X10^3$	$8X10^2$
	4	$5x10^4$	$6x10^3$	ND	-	$1X10^4$	$3X10^2$	$1X10^4$	$7X10^3$
	6	$3x10^5$	10^4	ND	-	$6X10^4$	$4X10^3$	$7X10^3$	$2X10^2$
	8	$8x10^5$	$6x10^4$	ND	-	$8X10^4$	$2X10^3$	$8X10^3$	$2X10^2$
1.0%	0	$3x10^3$	$2x10^2$	4	1.3	$4X10^2$	10^2	$4X10^2$	$2X10^2$
	2	$6x10^3$	$3x10^2$	ND	-	$4X10^3$	$2X10^2$	$3X10^3$	10^3
	4	$9x10^3$	10^2	ND	-	$1X10^4$	$3X10^2$	$3X10^3$	$2X10^2$
	6	$5x10^4$	$1x10^3$	ND	-	$9X10^3$	$6X10^2$	$6X10^3$	$4X10^2$
	8	$4x10^5$	10^4	ND	-	$3X10^4$	$1X10^3$	$8X10^3$	$3X10^2$
1.5%	0	$2X10^3$	$4X10^2$	3	-	$2X10^2$	10^2	$5X10^2$	$3X10^2$
	2	$4X10^3$	10^3	ND	-	$8X10^2$	$2X10^2$	$4X10^3$	$2X10^2$
	4	$6X10^3$	$2X10^3$	ND	-	$4X10^3$	$2X10^2$	$3X10^3$	10^3
	6	$5X10^4$	$4X10^3$	ND	-	$8X10^3$	10^3	$5X10^3$	$3X10^2$
	8	$7X10^5$	$3X10^4$	ND	-	$3X10^4$	$6X10^2$	$7X10^3$	10^3
2.0%	0	$5x10^3$	$2x10^2$	ND	-	$3X10^2$	10^2	$5X10^2$	10^2
	2	$3x10^3$	10^2	ND	-	$4X10^3$	$6X10^2$	$3X10^3$	10^3
	4	$4x10^3$	$3x10^2$	ND	-	$2X10^3$	$2X10^2$	$3X10^3$	$2X10^2$
	6	$2x10^4$	$4x10^3$	ND	-	$7X10^3$	10^3	$8X10^3$	$4X10^2$
	8	$8x10^4$	$6x10^3$	ND	-	$2X10^4$	$3X10^3$	$3X10^3$	10^3

T.PS.C = Total psychrophilic count
*S = spoiled
ND = not detected.

Table 4: Chemical values of treated beef kofta samples stored at 4C°

Time/ day	pH					TBARS (mg MD/ Kg)				
	0 %	0.5%	1%	1.5%	2%	0 %	0.5%	1%	1.5%	2%
0	6.08 ± 0.02	5.59 ± 0.01	5.46 ± 0.032	5.52 ± 0.041	5.43 ± 0.032	2.056 ± 0.39	1.1 68 ± 0.22	1.113 ± 0.12	0.690 ± 0.09	0.558 ± 0.21
2	6.06 ± 0.08	5.64 ± 0.04	5.60 ± 0.042	5.58 ± 0.06	5.83 ± 0.09	2.032 ± 0.43	1.618 ± 0.33	1.408 ± 0.22	0.992 ± 0.07	0.777 ± 0.25
4	5.94 ± 0.092	5.68 ± 0.03	5.39 ± 0.063	5.33 ± 0.034	5.15 ± 0.052	1.693 ± 0.09	1.397 ± 0.43	1.317 ± 0.22	1.288 ± 17	1.035 ± 0.13
6	6.23 ± 0.06	5.82 ± .062	5.72 ± 0.065	5.70 ± 0.030	5.93 ± 0.042	2.169 ± 0.27	1.432 ± 0.11	1.400 ± 0.32	1.311 ± 0.27	1.274 ± 0.26
8	*S	6.01 ± 0.031	5.98 ± 0.032	5.90 ± 0.02	5.88 ± 0.026	*S	1.633 ± 0.28	1.580 ± 0.34	1.423 ± 0.11	1.412 ± 0.32

* S = spoiled
TBARS = Thiobarbituric Acid Reactive Substanc

DISCUSSION

Sensory Quality

The results obtained in Table 1 show the sensory scores of grilled kofta after one day of shelf-life. Flavour and taste of control samples were unfavorable and might not be appealing to panelists than other treated samples. Flavour and taste were accepted by panelists with high score in samples treated with concentrations between 1 and 1.5% GTE. These results agree with those showed by Nirmal and Benjokul (2010). Green tea had not deteriorative changes in the sensory quality of beef steaks when marinated in their extract for six hours at 5°C (Qualhas *et al.*, 2010)

The changes in sensory characteristics during 8 days storage at 4°C recorded in Table 2 revealed that with extending the shelf-life of the samples, off-flavor was developed in all samples by various scores from low to high score parallel to concentrations of GTE from low to high concentrations. The early signs of off-flavor appeared in control and 0.5% groups at 6 day storage, and such off-flavour was developed in other treated groups after 6 days of storage. A marked discoloration changes of kofta samples treated 2.0% GTE was observed, this might be implicated to the possibly penetration of chlorophyll pigments and their subsequent interference with other biochemicaly active compounds in

subsequent interference with other biochemicaly active compounds in beef samples, which caused an undesirable change in meat colour (Sarah *et al.*, 2010). These results agree with those showed by Kumudavally *et al.* (2008); Jin-ling *et al.* (2009); Nirmal and Benjakul (2010).

Bacteriological quality:

From the results given in Table 3, it is noticed that total psychrophilic count reached the unacceptable limit (10^6 cfu/g) at 6th day in control group according to Egyptian Organization for Standardization and Quality Control (EOS, 2005). Total psychrophilic counts reached $8x10^5$; $4x10^5$; $7x10^5$ and $8x10^4$ cfu/g at 8th day in treated samples with 0.5%; 1.0%; 1.5% and 2.0 0% GTE respectively. The antimicrobial effects of green tea extract in meat is well confirmed by Maolinchun (2006); Kang *et al.* (2007) and Nirmal and Benjakul (2010). The polyphenols of green tea extract had strong effect on the growth of total viable bacteria and total psychrophilic counts at 5th and 10th day during ice storage of fish (Noriyuki *et al.*, 2001).

The acceptable limit for anaerobic spore forming bacteria in meat products do not exceed 10^2 cfu/g according to EOS (2005). *Clostridium perfringens* could be detected in little number of control samples during 0 and 2 day only with a mean value of 4 and 7 respectively. but the pathogen did not recovered from other treated groups. The concentration of 2.0% GTE samples showed more antimicrobial effect on *C. perfringens*. Juneja *et al.* (2007) confirmed that green tea extract has higher catechin content which is effective in controlling *C. perfringens* population densities during cooling of ground beef.

Also Sakanaka *et al.* (2000) found that the heat resistance *Bacillus stearothermmophilus* and C. *thermoaceticum* spores were more rapidly decreased by the addition of green tea polyphenols at high temperature. The differences in the obtained results may be attributed to the findings of Traci and Dunca (1974) who mentioned that a loss in the viability of *C. perfringens* cells may occur if foods were frozen or held under prolonged refrigeration. The inhibitory effects of GTE against *C. perfringens* were reported by Ahn *et al.* (1991); Juneja *et al.* (2006).

Most members of *Enterobacteriaceae* family are mainly mesophilic while some strains can grow at 0°C (Downes and Ito, 2001). The results in Table 3 confirmed the inhibitory effect of different concentrations of GTE compared to control sample. 1.0%, 1.5% and 2.0% GTE were more effective in lowering the *Enterobacteriaceae* counts compared to control and 0.5% GTE groups. These results agree with Byrne (2009) who showed that the population of the pathogenic

bacteria in pork loins meat packed with green tea extract film (GTE) 2.8% were significantly reduced during storage at 4C° from 5.47 log cfu/g to 4.47/log cfu/g after 10 days.

The inhibitory effect of green tea extract 2%, 4% and 6% against *E. coli*, *Pseudomonas aeruginosa; Serratia spp.; Bacillus subtilis*; *Enteobacteriaceae*; *coliform* counts and *Listeria monocytogenes* were reported by Jin-ling *et al.*(2009) and Nirmal and Benjakul, (2010).

The results showed that *Staph. aureus* counts of untreated samples (control) were higher than those of treated samples with GTE where the mean values of *Staph. aureus* of each treated samples (0.5% ; 1.0% ; 1.5% and 2.0%) were 8 x 10^3; 8×10^3 ; 7x10^3; and 3x10^3 cfu/g respectively at 8 days while the control samples reached 1x10^5 cfu/g at 6 day during chilling storage. The antibacterial activities of green tea extract (GTE) against *Staphylococcus* aureus were reported by Kim *et al.* (2004); Vasudeo and Sonika (2009) and Javier *et al.* (2010).

The Egyptian Standardization (EOS, 2005) of frozen ball listed that the permissible limits for *Staph. aureus* must be not exceed than 10^2 cfu/g. The inhibitory action of green tea polyphenols and catechin is probably due to their ability to complex with extracellular and soluble proteins and to complex with bacterial cell walls (Sakanaka *et al.*, 1996).

Chemical quality

The pH value assessed as a crucial factor for determination of meat quality (Nam *et al.*, 2001), might interfere with solubility activities of antioxidants by changing in their electrical charges (Decker *et al.*, 2005). Changes in pH value of treated beef kofta samples and control are shown during 8 days storage in Table 4. A gradual increase in the pH value was detected until day 4 while the pH values of treated samples showed a degree of stability by an increase in the amount of green tea extract added. The increase in meat pH value at storage period may be due to an increase in valotile bases compounds produced by either endogenous or microbial enzymes, and decomposition of nitrogenous components and increase of ammonia and free amine group produced in meat (Cann *et al.*, 1983; Sikorski *et al.*, 1990; Benjakul *et al.* 2002).

pH values of vacuum infused fresh chicken breast meats with green tea extracts stored at 5°C ranged from 5.98 to 6.16 (Rababah *et al.*, 2006-a). There was gradual changes in pH values of treated fish fillets samples with 1%; and 2.5% GTE from 6.51 to 6.81 during storage period at 4°C (Sarah *et al.*, 2010). Meanwhile, Maolinchun (2006) confirmed that 0.1% of tea polyphenols had no significant effects on pH values by dipping of fish in (GTE) for one hour at 3°C.

The results obtained in Table 4 revealed that the mean value of TBARS reached 2.161 mg/kg in the control samples at 6th day, while it reached 1.633; 1.580; 1.423 and 1.412 mg/kg in 0.5%; 1.0%; 1.5% and 2.0% (GTE) treated samples at 8th day respectively. The acceptable limit for TBA in meat do not exceed 0.9 mg/kg according to EOS (2005). It is evident that TBARS increased gradually with the time of meat storage due to formation of maloneldehyde (Gray and Crakal, 1992). Malonaldhyde production in food may be affected by temperature, fat amount in the product, the degree of unsaturation of fatty acids (Devore, 1988). These findings agree with Hüseyin, (2006); Maolinchun, (2006); Ko and Yang, (2008); Jin-ling *et al.* (2009); Dembele *et al.* (2010); Nirmal and Benjakul (2010) which confirmed the positive correlation between higher concentrations of green tea extract (2%, 4% &6%) (Phenolic and catechins content) and antioxidant properties of these compounds to retard the formation of malonaldehydes and TBARS values, control of lipid oxidation and preventing undesirable change in chemical properties in meat samples.

Furthermore Rababah *et al.* (2006-a) Found that TBARS values of uncooked (raw) chicken breast meats treated with green tea extract for 0 to 12 day of storage at 5C° ranged from 1.12 to 3.5 mg of malonaldehyde/ 100g while (TBARS) ranged from 2.50 to 7.80 mg/100g and from 2.4 to 7.35 mg/100g of chicken breast meat cooked by microwave and conventional electric oven, respectively. On the other wise Sarah *et al.* (2010) found much more reduction of TBARS values in 2.5% and 5% GTE treated fish fillets stored up to 8 days at 4C°, relative to other samples where (TBARS) valued from 0 to 8 days (0.13± 0.01 to 0.97 ± 0.09) and (0.11± 0.02 to 0. 80 ± 0.25) for 2.5% and 5% GTE respectively, while 1% GTE were (0.14± 0.01 to1.84± 0.09). Rababah *et al.* (2006-b) also found that TBARS values from 0 to 12 days ranged from (16.1-38.0 mg/kg) and (16.4- 67.8 mg/kg) for non irradiated raw chicken breast meat infused with green tea extract (3.000 ppm) and control samples respectively during storage at 5C°. Meanwhile Sarker *et al.* (2010) found that the mean TABA values in fresh broiler meat for control, 0.5% and 1.0% green tea samples were 2.31± 0.09 ; 1.69± 0.13 and 2.22 ± 0.19 umol/l00g, respectively.

In conclusion the addition of 1.0 to 1.5% green tea extract to traditional Egyptian kofta resulted in the best kofta quality with extending their shelf-life up to 8 day under chilling storage. Panelists accepted the flavour and taste of treated products with concentration up to 1.5%. At this concentration, green tea extract can minimize the

undesirable changes in microbiological and chemical properties which may be developed during storage.

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