

# Utilization of Some Artichoke Processing Wastes In Elongation of Cold Storage of Meat Patties

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## ABSTRACT

The edible part of artichoke head is receptacle, meanwhile other parts represent wastes are removed during the processing of artichoke although they contain a considerable amount of phenolic compounds and antioxidant activity, so the present study aimed to utilize of these wastes in preservation of meat patties during cold storage compared to some artificial preservatives such  $\text{SO}_2$  and sodium ascorbate .Six samples of meat patties with deferent levels of artichoke wastes extract and/or  $\text{SO}_2$  and sodium ascorbate were prepared. Colour , pH value, oxidative stability and bacterial load were estimated for all samples during the cold storage period ( 0, 3, 6, 9 days). Data showed that, red colour of meat patties samples decreased significantly, meanwhile blue colour increased significantly and slightly changes occurred in yellow colour in all samples during storage. Samples which contained artichoke wastes extract showed a slight changes in pH value compared with other treatments during storage . Addition of artichoke wastes to meat patties reduced the total count of bacteria compared to control sample and those with  $\text{SO}_2$  and sodium ascorbate, meanwhile samples treated with artichoke wastes extracts had no coliform group till the end of storage period. Artichoke wastes extract could retard oxidation and kept each of peroxide value and thiobarbituric acid low during storage compared with control one or those contained artificial preservatives. All samples of different treatments were accepted by panelists in all organolyptic properties within storage period except control treatment and treatment with  $\text{SO}_2$ .

**Keywords:** Artichoke, artichoke wastes, meat patties, antioxidants, phenolic content, natural antioxidant.

## INTRODUCTION

Consumers increasingly demand healthier meat products, if possible free of chemical additives. The use of natural preservatives to increase the shelf life of meat products is a promising technology since many vegetable substances have antioxidant and antimicrobial properties (Banon *et al.*, 2007). Phenolic compounds are commonly found in both edible and nonedible plants, and they have been reported to have multiple biological effects, including antioxidant activity (Loliger, 1991). Crude extract of fruits, herbs, vegetables, cereals, and other plant materials rich in

phenolic compounds are increasingly of interest in the food industry because they retard oxidative degradation of lipids and thereby improve the quality and nutritional value of food (Loliger, 1991). The importance of the antioxidant constituents of plant materials in the maintenance of health and protection from coronary heart disease and cancer is also raising interest among scientists, food manufacturers and consumers as the trend of the future is moving towards functional food with specific health effects (Loliger, 1991). Artichoke is of special interest due to its high content of phenolic compounds, globe artichoke (*Cynara scolymus* L.), belonging to the family of *Asteraceae* (Compositae), is an herbaceous perennial crop, widely cultivated in the Mediterranean area, (Bianco, 2005). The heads, i.e., the large immature inflorescences with edible fleshy leaves (bracts) and receptacle, are used worldwide and represent a fundamental ingredient of the Mediterranean diet. The phenolics in artichoke include cynarin (1,3-di-O-caffeoylquinic acid), luteolin, cynaroside (luteolin-7-O- glucoside), scolymoside (luteolin-7-rutinoside); phenolic acids such as caffeic, coumaric, hydroxycinnamic, ferulic, caffeoylquinic acid derivatives; mono- and dicaffeoylquinic acids, including chlorogenic; acid alcohols; flavonoid glycosides, among others, ( Fratianni *et al.*, 2007). The present of phytochemical in artichoke has been well documented, the leaves being higher in medical value than flowers, with antihepatotoxic, choleretic, diuretic, hypocholesterolemic and antilipidemic properties that are attributed to the phenolic composition (Mulinacci *et al.*, 2004). The residues proceeding from artichoke industry can form up to 60% of the harvested plant materials, the final management of these wastes representing an additional problem. Until the present, the common disposal of artichoke raw material is as organic mass, animal feed, and fuel and fiber production. Nonetheless, owing to the antioxidants capacity of polyphenols and their possible implication in human health in prevention of cancer, cardiovascular diseases and other pathologies. Artichoke raw material being subjected to new chemical analysis to determine its phenolic composition (Rabaneda *et al.*, 2003). The chemical composition of artichoke leaves have been

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studied extensively and have been found to be a rich source of polyphenolic compounds, with mono- and dicaffeoylquinic acids and flavonoids as the major chemical components (Dranik *et al.*, 1996).

The present study aimed to utilize of antioxidant and antimicrobial chemical substances of industrial processing artichoke wastes in increasing the shelf life of meat patties by using of artichoke waste extract in different concentration comparing with sulphur dioxide and sodium ascorbate as a common preservatives in meat processing.

## MATERIALS AND METHODS

### Materials:-

Artichoke processing wastes including outer and inner bracts, pedicle of artichoke head and part of receptacle, whose remain after artichoke processing were used in this study. Artichoke processing wastes were obtained from Sonac company for preservative food and brought to pilot plant of Food Science and Technology Department, Faculty of Agriculture, Alex. University. The samples were minced 3 times through a meat mincer then dried at  $40 \pm 5^\circ\text{C}$  in an air oven until drying (24 hrs), ground to pass through 60 mesh sieve, packed in polyethylene bags and kept at room temperature until used.

Boneless lean beef meat and beef tallow, common salt, and polyethylene bags were brought from the local market at Alexandria city, Egypt.

**Analytical chemicals:-** The chemicals used in this study were obtained from Food Science and Technology Department, Faculty of Agriculture, Alex. University, Egypt.

### Methods:-

#### Technological methods:-

**Meat patties preparation:** The boneless lean beef meat was minced after mixing with beef tallow at ratio of 9:1 w/w by passing three times through a 5 mm plate of meat mincer, then 2% common fine salt, was added to minced meat.

Six treatments of meat patties with different levels of preservatives (mg per Kg of meat) were prepared as follows: -

A (control without preservatives), B (meat + 100  $\text{So}_2$  as sodium metabisulfate), C (meat + 100  $\text{So}_2$  + 400 sodium ascorbate), D (meat + 100  $\text{So}_2$  + 200 artichoke waste extract), E (meat + 400 artichoke waste extract) and F (meat + 800 artichoke waste extract).

Patties were formed using a burger machine (100 g / patty), to give average dimensions of 10 cm diameter and 1.5 cm thickness. Each piece was surrounded with two pieces of butter paper before filling in polyethylene

bags. Each bag was electric sealed before storing at  $5^\circ\text{C}$  in refrigerator. (Amin and Keshk, 2008).

### Physical methods:-

Colour of the prepared meat patties was determined using Lovibond Schofield Tintometer and expressed as blue, yellow and red colour fractions (Makinney and Little, 1962). pH of meat patties was measured using Digital 500 Eutech Cybernetics Scan pH meter after blending 15 g meat patties with 150 ml deionized water for 2 min. (Xiong *et al.*, (1993).

### Chemical methods:-

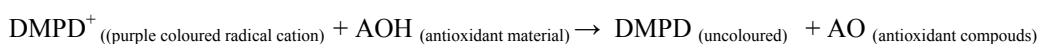
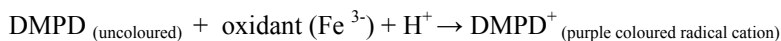
**Analytical methods:-** Moisture, Protein, crude ether extract and ash contents of meat patties were determined according to AOAC (1998). Carbohydrate content was calculated by difference. Thiobarbituric acid (TBA) as mg malondialdehyde/Kg meat patties was spectrophotometrically determined at 532 nm using Spectronic 601-Milton-Ray spectrophotometer as mentioned by Siu and Draper (1978). Peroxide value was determined according to Pearson *et al.*, (1981).

### Preparation of artichoke waste extracts:

The artichoke waste extract was obtained by extraction of wastes (bracts, part of receptacles and pedicle of heads) from fresh-handling and industrial processing of artichoke hearts with methanol. The artichoke wastes (500 g) was crushed and then extracted three times with 2 l of the solvent by stirring for 4 h at  $40^\circ\text{C}$ . After filtration through a folder filter, the supernatants were joined and concentrated under reduced pressure using a rotary evaporator until dryness (Rabaneda *et al.*, 2003).

**Determination of total phenolic content:-** The total phenolic content was determined in the extract following the Folin-Ciocalteu method (Singleton & Rossi, 1965). The reaction mixture was composed of 0.1 ml extract, 7.9 ml distilled water, 0.5 ml of Folin-Ciocalteu's reagent, and 1.5 ml of a 20% sodium carbonate anhydrous solution (added 2 min after the Folin – Ciocalteu's reagent). After initial mixing the opaque flasks were allowed to stand for 2 hrs. The optical density of the blue coloured samples was determined as gallic acid equivalents (GAE) and the values are expressed as mg of gallic acid/100g artichoke wastes.

**Antioxidant activity:-** Antioxidant activity was measured by the N,N-Dimethyl -p- phenylenediamine dihydrochloride (DMPD). Two hundred and nine mg of DMPD were dissolved in 10 ml of deionized water. One ml of this solution was added to 100 ml of 0.1 M acetate buffer (pH= 5.25) then 0.2 ml of 0.05 M ferric chloride solution was added to obtain coloured radical cation ( $\text{DMPD}^+$ ) as follows:



One ml of this solution was directly placed in 1 ml plastic cuvette and its absorbance was measured at 505 nm. Standard solution of the antioxidant compounds was prepared as follows: 0.1 g of ascorbic acid was dissolved in 100 ml of deionized water to obtain 1 mg/ml of ascorbic acid. Antioxidant compounds were extracted from samples as follows: One g dried sample was added to 10 ml methanol, then centrifuged at 2000 Xg for 15 min. A volume of 50 µl of standard antioxidant or sample extraction was added in the spectrometric cuvette contained 1 ml of DMPD<sup>+</sup> solution, and after 10 min at 25°C under continuous stirring, the absorbance was measured at 505 nm. Buffered solution was placed in the reference cuvette. A dose-response curve was derived for ascorbic acid, by plotting the absorbance at 505 nm as percentage of the absorbance of the uninhibited radical cation solution according to the following equation:

$$\text{Inhibition of } A_{505} (\%) = (1 - A_F / A_0) \times 100$$

Where:

$A_0$  = Absorbance of uninhibited radical cation.

$A_F$  = Absorbance measured at 10 min after the addition of antioxidant samples. (Fogliano *et al.*, 1999).

**Microbial analysis:** Ten grams of meat patties were blended with 90 ml of sterilized peptone water for 5 min in a sterilized stomacher 400 (Colworth, London, UK) for 1 min. Appropriate dilution from  $10^{-1}$  to  $10^{-6}$  were prepared in sterilized peptone water to select the suitable one for enumeration using microbiological pour plate technique and recommended culture media (Gerhardt *et al.*, 1994). Coliform were detected by lactose broth, after incubating at 30 °C for 48 hrs. while total bacteria were counted on plate count agar (PCA).

**Sensory evaluation:** Colour, odour, taste and texture of the meat patties were subjectively evaluated using 10 panalists of Food Science and Technology Department, Faculty of Agriculture, Alex. University, Egypt. Hedonic ranking test where 9=extremely acceptable to 1= extremely rejected as described by Kramer and Twigg (1970).

**Statistical procedures:** F-test, and analysis of variance of treatments difference was performed according to Steel and Torrie (1980). Statistical analysis was done by, ANOVA, FACTOR F-test, and L.S.D. procedures available within the SAS software package (version 9.13 2008). Histograms were produced using Harvard graphics software (HG, version, 5. 2003).

## RESULTS AND DISCUSSIONS

### Polyphenols and antioxidant activity of artichoke wastes extract:-

Data in Table (1) show that, artichoke wastes extract have a considerable amount of total polyphenols 421.8 mg/100 g, and a relatively high percent of antioxidant activity (63.00 %), these results confirmed possibility of using the extract as antioxidant source. Rabaneda *et al.*, (2003) reported that 45 phenolic compounds were identified in artichoke waste, some of which have been reported to exhibit activity as free radical scavengers and quenchers of reactive oxygen species. Fratianni *et al.*, (2007) found that, globe artichoke is considered a healthy food due to its nutritional and phytochemical composition. It contains a high proportion of phenolics. Meanwhile Pandino *et al.*, (2011) confirmed that the bracts of globe artichoke could have an added economic value if exploited for the extraction of phenol compounds.

### Proximate analysis of fresh meat patties:-

Table (2) shows the proximate analysis of meat patties used in this study, where it had 68.94% moisture, 17.54% protein, 9.56% fat, 1.94 % ash and 2.02 % carbohydrate on fresh weight basis. Data of Greenfield *et al.*, (1981) showed that commercial hamburger contained 10.7-13.6% protein, 11.2-13.3% fat, 1.8-1.9% ash. 3.4-4.1% sugar and 16.6-18.5% starch on wet weight basis. Keshk *et al.*, (2008) found that the moisture, protein, ether extract, ash and carbohydrates were ranged from 68.95 to 70.99, 15.32 to 15.6, 10.24 to 11.67, 2.29 to 2.34 and 1.05 to 1.92 %, in beef burger, respectively

**Table 1. Total Polyphenols and antioxidant activity of artichoke waste extract**

Component	Polyphenols (mg/100g dry artichoke waste sample)	Antioxidant activity %
Total polyphenols	421.80 ± 1.6	63.00 ± 2.4

**Table 2. Proximate analysis of fresh meat patties before addition of artichoke waste**

component	% in Beef burger sample (on wet weight basis)
Moisture	68.94 $\pm$ 0.21
Protein	17.54 $\pm$ 0.43
Crude ether extract	9.56 $\pm$ 0.11
Ash	1.94 $\pm$ 0.05
Carbohydrates *	2.02 $\pm$ 0.04

\* Carbohydrates value was calculated by difference.

#### **Storage stability of meat patties as affected by artichoke waste extract:-**

**Colour and pH values:-** Colour values of meat patties were evaluated using Lovibond Schofield Tintometer and shown in Table (3). Generally from the results it can be noticed that the patty samples trend to be red to yellow in colour. Also it can be concluded that, there was no significant differences in blue colour between all studied samples at zero time of storage, but blue colour significantly increased within storage period in all samples. The results also indicated that, at zero time of storage there was no significant differences between samples A, B, C and D for yellow color, whereas there was a significant increasing in it in sample E and F whose contained artichoke wastes extract. However, there was a slightly change in yellow color for all samples within storage. Meanwhile, the red colour was the dominant color in all samples at zero time, but it significantly decreased in all samples within storage period. Also, as it shown from the results, in the beginning of storage period red color was high in samples A and B followed by samples C, D, E and more less in sample F, but at the end of the storage period sample F represented the highest value of red colour among the other 9 days stored samples. Moreover, almost all the patty samples trend to be more yellow to red colour at the end of storage period. Banon *et al.*, (2007) confirmed the changes of colour that are normally associated with the loss of redness in meat during storage.

Table (4) illustrates pH values for studied meat patty samples control one and samples after addition of artificial preservatives and artichoke extracts, the results indicated that, there were significant differences between pH values of all treatment at zero time and during storage period. At zero time of storage control sample (A) had a highest value of pH followed by sample F, E, B, C and D, in descending order. During storage time, there were a noticed significant differences in pH values between stored meat patty samples, where, pH values of control sample were decreased from 5.76 to 4.63 during the storage period up to 9 days.

Also pH values of sample B decreased significantly after storage period of 6 and 9 day and the same trend was observed for sample D, this decrease in pH values, perhaps, is due to growth of some strains of microorganism that produce acids in stored meat patties samples. Samples E and F which contained artichoke extract showed a slightly change in PH values. Aleson-Carbonell *et al.*, (2004) reported that commercial hamburger had 5.24 – 6.4 pH values.

**Bacterial count:** It is known that refrigeration at 5°C does not kill microorganisms but able to retard their growth and slow the rate of both enzymatic and nonenzymatic changes. Data in Table (5) show the total count of bacteria and the detection of coliform group in studied meat patty samples during storage period, from the results it can be noticed that, in control sample there was a noticeable increment in total count of bacteria within time and at 9 days of storage the plate was very crowded with colonies and could not be detected. After 3 days of storage the large number of colonies were found in control sample (A) followed by B, D, E, C and F treatment in descending order. Total count of bacteria was maximized at the end of storage period (after 9 days of storage) in treatment A followed by B, D, C, E and F treatment in descending order. From the above results it can be concluded that, at the end of cold storage period of meat patty samples, sample F which was containing 800 mg artichoke extract/Kg meat patties had a lowest number of bacteria within storage followed by treatment E which had 400 mg artichoke extract/Kg meat patties, treatment C with 100 mg  $\text{So}_2$  + 400 mg sodium ascorbate, treatment D with 100mg  $\text{So}_2$  + 200 mg artichoke wastes extract and finally treatment B with 100 mg  $\text{So}_2$  in ascending order. Coliform group were not detected in all treatments at zero time of storage, meanwhile they were detected in treatment A after 3 days of storage and treatment A and B after 6 and 9 days of storage. Jay (1986) reported that most food have total viable count less than  $10^6$  /g have an acceptable quality, which those having  $10^7$  to  $10^8$  cfu/g are generally have detectible off flavour. Mossi and Echeverrigaray (1999) confirmed the antimicrobial effect of artichoke extract against Gram positive

**Table 3. Changes in color of meat patties contained artichoke waste extract during cold storage**

Storage period	Zero time			3 days			6days			9days		
	Blue	Yellow	Red	Blue	Yellow	Red	Blue	Yellow	Red	Blue	Yellow	Red
<b>Treatment</b>												
A	1.9±0.01	5.0±0.2	9.6±0.6	3.7±0.2	4.3±0.34	5.6±0.5	3.9±0.1	4.6±0.5	5.1±0.2	3.5±0.3	6.2±0.1	5.1±0.2
B	1.9±0.1	5.0±0.2	9.0±0.4	4.7±0.2	5.0±0.2	4.3±0.1	3.3±0.2	5.0±0.05	5.2±0.2	4.4±0.3	5.6±0.5	4.7±0.4
C	2.0±0.2	5.0±0.3	8.0±0.4	4.7±0.2	5.3±0.3	5.2±0.3	4.3±0.4	5.0±0.06	5.0±0.3	3.5±0.2	6.4±0.2	4.8±0.5
D	2.2±0.2	5.0±0.1	8.3±0.1	4.8±0.1	5.3±0.15	4.7±0.2	3.7±0.5	5.0±0.04	4.7±0.1	3.7±0.04	5.1±0.2	5.1±0.2
E	2.0±0.3	6.0±0.2	8.2±0.2	4.3±0.1	5.5±0.1	4.8±0.2	4.1±0.1	5.0±0.4	4.6±0.4	4.7±0.4	5.5±0.2	4.7±0.2
F	2.2±0.2	6.0±0.3	7.8±0.4	4.5±0.05	5.0±0.3	4.1±0.1	4.4±0.4	5.0±0.2	4.4±0.4	4.8±0.3	5.1±0.4	5.5±0.3

A: Control (without preservatives)

B: Containing 100 mg So<sub>2</sub>/Kg meatC: Containing 100mgSo<sub>2</sub>+ 400 sodium ascorbate / Kg meatD : Containing 100mgSo<sub>2</sub>+ 200 artichoke wastes extract/ Kg meat

E: Containing 400 mg artichoke waste extract/Kg meat

F: Containing 800 mg artichoke waste extract/Kg meat

LSD<sub>0.05</sub> for blue color = 0.7593.LSD<sub>0.05</sub> for yellow color = 0.4624.LSD<sub>0.05</sub> for red color = 0.7078.

**Table 4. Changes in pH value of meat patties within cold storage**

Storage period pH value	Zero time	3 days	6days	9days
A	5.76 <sup>a</sup> ± 0.05	4.26 <sup>j</sup> ± 0.05	4.46 <sup>ij</sup> ± 0.4	4.63 <sup>ghij</sup> ± 0.28
B	5.23 <sup>cde</sup> ± 0.3	5.30 <sup>bcd</sup> ± 0.1	4.50 <sup>hij</sup> ± 0.38	4.73 <sup>fghi</sup> ± 0.15
C	5.16 <sup>def</sup> ± 0.15	5.10 <sup>def</sup> ± 0.1	4.86 <sup>efghi</sup> ± 0.9	5.10 <sup>def</sup> ± 0.17
D	5.06 <sup>defg</sup> ± 0.2	5.76 <sup>a</sup> ± 0.05	5.43 <sup>abcd</sup> ± 0.43	4.93 <sup>efgh</sup> ± 0.15
E	5.43 <sup>abcd</sup> ± 0.16	5.46 <sup>abcd</sup> ± 0.15	5.70 <sup>ab</sup> ± 0.19	5.16 <sup>def</sup> ± 0.05
F	5.66 <sup>abc</sup> ± 0.05	5.26 <sup>bcd</sup> ± 0.05	5.28 <sup>bcd</sup> ± 0.24	5.23 <sup>cde</sup> ± 0.05

A: Control (without preservatives)

B: Containing 100 mg SO<sub>2</sub>/Kg meat

C: Containing 100mgSO<sub>2</sub> + 400 sodium ascorbate / Kg meat

D: Containing 100mgSO<sub>2</sub> + 200 artichoke wastes extract / Kg meat

E: Containing 400 mg artichoke wastes extract/Kg meat

F: Containing 800 mg artichoke wastes extract/Kg meat

Means in column or row not sharing the same manuscript are significantly different at  $P \leq 0.05$

bacteria. Capita *et al.*, (2004) stated that the enumeration of total aerobic count and *Enterobacteriaceae* gives information about the hygienic performances of meat production. Banon *et al.*, (2007) reported that, addition of 100 mg SO<sub>2</sub>/kg was not sufficient to delay the growth of total aerobic bacteria and total coliforms in raw beef patties. Results in Table (5) indicated that addition of artichoke wastes extract to the meat patties decreased the total count of bacteria during storage period compared to control samples (without preservatives) and those with SO<sub>2</sub> and sodium ascorbate. Meanwhile samples with artichoke wastes extracts had no coliform group till the end of cold storage period (9 days). These results confirmed possibility of using artichoke wastes extract as antimicrobial agent.

**Peroxide value and thiobarbituric acid:-** Figure(1) shows peroxide values of stored meat patties. From the Figure, it can be noticed that there was significant increase in peroxide values of all samples specially the control one compared with other treatments. At the end of cold storage period (9 days), peroxide values reached to 6.15, 4.49, 4.29, 3.58, 3.35 and 2.37 m.eq.O<sub>2</sub> / Kg in samples A,D,B,E,C and F respectively. Figure (2) shows the changes in thiobarbituric acid (TBA) of studied meat patties at zero time and within storage period ( 3,6 and 9 days). From the Figure it can be summarized that, there was a gradual increase in TBA values during cold storage of meat patties, all samples had low value of TBA at zero time, meanwhile, increasing TBA values was more pronounced in control sample compared with others during storage period. At the end of storage, the TBA values reached 1.6, 0.84, 0.62, 0.48,0.43 and 0.28 mg malondialdehyde/Kg in samples A,B,C,D,E and F, respectively.

From the results of peroxide and thiobarbituric acid values it can be concluded that addition of artichoke extract to meat patties could retard oxidation process and keep each or TBA and PV value low compared with the control one (without preservatives) or those which contained artificial preservatives. Mossi and Echeverrigaray (1999) reported that in various pharmacological test systems, artichoke leaf extracts have shown antibacterial, antioxidative, bile-expelling, hepatoprotective, urinate, and choleretic activities as well as the ability to inhibit cholesterol biosynthesis and LDL oxidation. McCarthy *et al.*, (2001) and Tang *et al.*, (2001) reported that the natural equivalent of synthetic antioxidants is important with regard to human health because some synthetic antioxidants have carcinogenic activity and their usage in food industry more than natural antioxidants. The results of Banon *et al.*, (2007) pointed to the possibility of using low SO<sub>2</sub>-vegetable extract combination to preserve raw meat products.

**Organoleptic properties:-** As seen from the results in Table (6) panelists accepted the determined organoleptic properties of meat patties free or containing preserving agent or artichoke extracts , all treatments were accepted within storage period except A and B treatments. Treatment A was unacceptable in all properties after 6 days of storage, meanwhile, treatment B was unacceptable for odour ,taste and texture at the end of storage period. Samples for other treatments were acceptable in all organoleptic properties until the end of cold storage period (9 days). Banon *et al.*, (2007) reported that in general, minor losses of colour, odour, flavour and texture were observed during storage of meat patties.

**Table 5. Changes in microbial load (CFU/g) of meat patties within cold storage**

Storage period	Zero time		3days		6 days		9 days	
	Total count	Coliform	Total count	Coliform	Total count	Coliform	Total count	Coliform
<b>Treatments</b>								
A-	25 x 10 <sup>1</sup>	-	65 x 10 <sup>1</sup>	+	300 x 10 <sup>1</sup>	+	ND*	+
B-	23 x 10 <sup>1</sup>	-	52 x 10 <sup>1</sup>	-	103 x 10 <sup>1</sup>	+	250 x 10 <sup>1</sup>	+
C-	25 x 10 <sup>1</sup>	-	32 x 10 <sup>1</sup>	-	93 x 10 <sup>1</sup>	-	160 x 10 <sup>1</sup>	-
D-	28 x 10 <sup>1</sup>	-	43 x 10 <sup>1</sup>	-	100 x 10 <sup>1</sup>	-	203 x 10 <sup>1</sup>	-
E-	24 x 10 <sup>1</sup>	-	40 x 10 <sup>1</sup>	-	90 x 10 <sup>1</sup>	-	106 x 10 <sup>1</sup>	-
F-	22 x 10 <sup>1</sup>	-	31 x 10 <sup>1</sup>	-	66 x 10 <sup>1</sup>	-	80 x 10 <sup>1</sup>	-

A: Control (without preservatives)

B: Containing 100 mg So<sub>2</sub>/Kg meatC : Containing 100mgSo<sub>2</sub> + 400 sodium ascorbate / Kg meatD : Containing 100mgSo<sub>2</sub> + 200 artichoke wastes extract / Kg meat

E: Containing 400 mg wastes extract/Kg meat

F: Containing 800 mg artichoke wastes extract/Kg meat

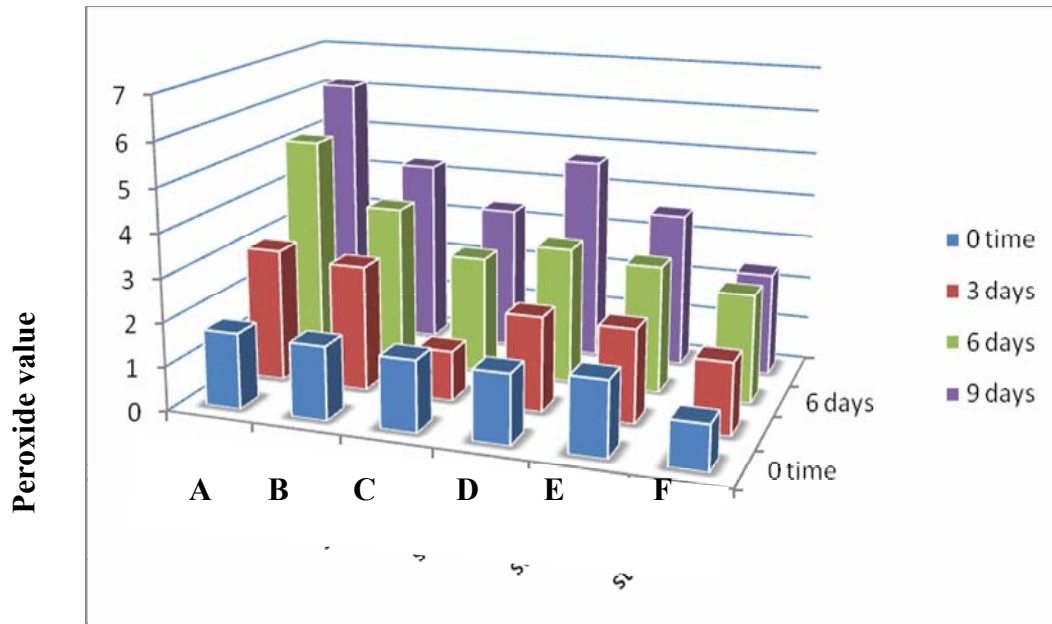
\* Not detected

Table 6. Changes in sensory properties of meat patties within cold storage

Property	Colour					Odour					Taste					Texture				
Storage period (day)	0	3	6	9		0	3	6	9		0	3	6	9		0	3	6	9	
A	Ac	Ac	Ac	Ac	N.Ac	V.Ac	Ac	N.Ac	N.Ac		Ac	Ac	N.Ac	N.Ac		V.Ac	Ac	Ac	Ac	
B	V.Ac	Ac	Ac	Ac	Ac	V.Ac	Ac	Ac	N.Ac		Ac	Ac	N.Ac	Ac		V.Ac	Ac	Ac	Ac	
C	V.Ac	V.Ac	Ac	Ac	Ac	V.Ac	Ac	Ac	Ac		Ac	Ac	Ac	V.Ac		Ac	Ac	Ac	Ac	
D	Ac	Ac	Ac	Ac	Ac	V.Ac	Ac	Ac	Ac		V.Ac	Ac	Ac	Ac		Ac	Ac	Ac	Ac	
E	V.Ac	Ac	Ac	Ac	Ac	Ac	Ac	Ac	Ac		Ac	Ac	Ac	Ac		Ac	Ac	Ac	Ac	
F	V.Ac	Ac	Ac	Ac	Ac	Ac	Ac	Ac	Ac		Ac	Ac	Ac	Ac		Ac	Ac	Ac	Ac	

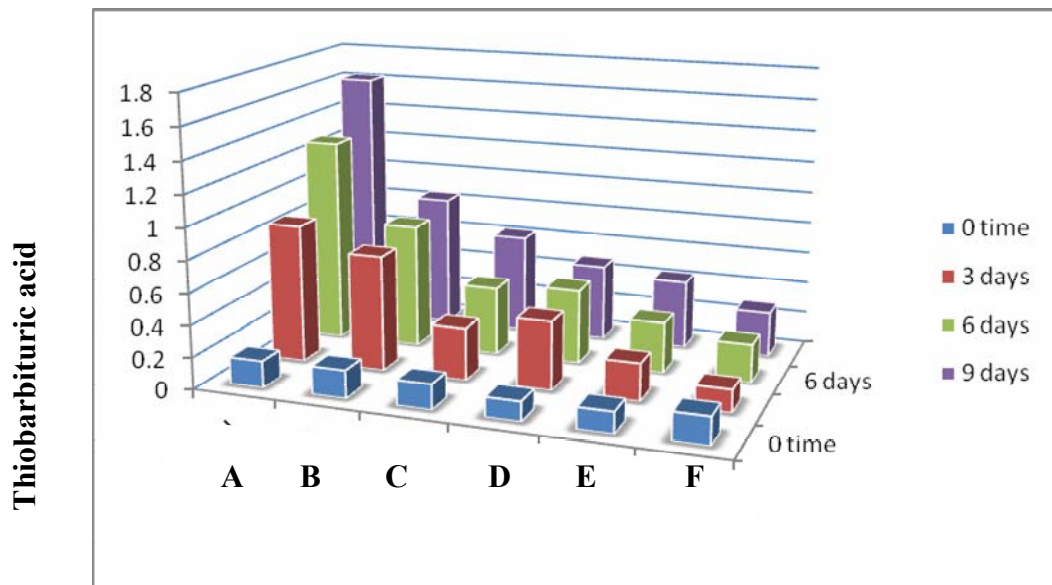
Ac: Accepted    V.Ac: Very accepted    N.Ac: Not accepted  
A: Control (without preservatives)  
B: Containing 100 mg So<sub>2</sub>/Kg meat  
C: Containing 100mgSo<sub>2</sub> + 400 sodium ascorbate /Kg meat  
D: Containing 100mgSo<sub>2</sub> + 200 artichoke wastes extract / Kg meat  
E: Containing 400 mg artichoke wastes extract/Kg meat  
F: Containing 800 mg artichoke wastes extract/Kg meat





**Fig .1. Changes in peroxide value of cold stored meat patties**

- A: Control (without preservatives)  
 B: Containing 100 mg  $\text{SO}_2$ /Kg meat  
 C: Containing 100mg $\text{SO}_2$  + 400 sodium ascorbate / Kg meat  
 D: Containing 100mg $\text{SO}_2$  + 200 artichoke wastes extract / Kg meat  
 E: Containing 400 mg artichoke wastes extract/Kg meat  
 F: Containing 800 mg artichoke wastes extract/Kg meat



**Fig.2. Changes in thiobarbituric acid (TBA) of cold stored meat patties**

- A: Control (without preservatives)  
 B: Containing 100 mg  $\text{SO}_2$ /Kg meat  
 C: containing 100mg $\text{SO}_2$  + 400 sodium ascorbate / Kg meat  
 D: Containing 100mg $\text{SO}_2$  + 200 artichoke wastes extract / Kg meat  
 E: Containing 400 mg artichoke wastes extract/Kg meat  
 F: Containing 800 mg artichoke wastes extract/Kg meat

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