Middle East Journal of Applied Sciences
ISSN 2077-4613

Volume : 05 | Issue : 04 | Oct.-Dec.| 2015
Pages: 869-878

Influence of the Addition of Chili Pepper (as Phytochemical Rich Components) on the Quality Characteristics of Beef Burger Patties

[1]A. M. Sharaf, [1]M. E. Abd- ElGhany, [2]F. O. F. Abou-Zaid and [1]A. Zaghlool

[1]Department of Food Science and Technology, Faculty of Agriculture, AL-Azhar University, Cairo, Egypt.
[2]Department of Plant Production, Desert Research Center, Cairo, Egypt.

ABSTRACT

The objective of this study was to use Chili pepper powder (CPP) as containing high components of phytochemical in formula of beef Burger patties, at levels of 1,2 and 3% and the effect of this addition on the quality characteristics of beef burger patties during frozen storage at -18±2°c for 3 months was investigate. The antimicrobial activity of ethanolic extracts of CPP was evaluated, and the results indicated that, it was highest value against Gram-negative followed by Gram-positive, fungi and yeasts. Also, the addition of CPP at studded levels was increased the content of phytochemical components that caused an improvement of physiochemical quality criteria (pH value, WHC, cooking loss, cooking shrinkage, TVN and TBA contents) during frozen storage ,as well as the improvement of the microbiological quality, was observed when compared to control burger. Also, beef burger samples CPP exhibited a good sensory properties and better acceptability, especially those contained 1 and 2%, even after frozen storage for 3 months.

Key words: Chili pepper - Phytochemical components - Beef burger - Meat manufacture - Frozen storage- microbial criteria.

Introduction

Capsicum is a genus of plant under the family of *Solanaceae*, and this capsicum has varieties of names according to their location and type. The most familiar peppers names are chili, bell, red, green or just called as pepper (Faustino *et al*., 2007). Chili (*Capsicum annum* Linn.) are fruit-vegetable that commonly found in multiethnic of Malaysian's daily food menu. They are extremely popular for the huge content of vitamin C and total soluble phenolics higher than other vegetables commonly recognized as a source of this substance (Marinova *et al*., 2005; Aniel kumar *et al*., 2009). Now a day's chili is an important vegetables crops and used world-widely as for flavour, aroma and add colour to foods (Zhuang, *et al*., 2012).

Pepper fruits contain a wide array of phytochemicals with well-known antioxidant properties including polyphenols (Shaha *et al.,* 2013). Phenolic contents were reported in the range of 33-250mgGAC/100g FW by several authors for different sweet and hot peppers (Alvarez-Parrilla *et al*., 2011). Red Pepper is an important agricultural crop, not only because of its economic importance, but also due to nutritional and medicinal value. These are the excellent source of natural colors and antioxidant compounds (Howard *et al*., 2000). A wide spectrum of antioxidant, vitamins, carotenoids, and phenolic compounds are present in pepper. The intake of these compounds in food is an important health-protecting factor by prevention of widespread human diseases. As consumption continues to increase, red peppers could provide important amounts of nutritional antioxidants to the human diet (Esayas *et al*., 2011).

Emmanuel-Ikpeme *et al*., (2014) studied that the phytochemical composition, vitamins composition, minerals composition, proximate composition and microbiological quality of *capsicum annuum* (Drum pepper), capsicum genus (Long chili pepper), and capsicum frutescens (Small chili pepper). They found that the pepper varieties contain substantial quantities of minerals, vitamins, and phytochemicals. Also they observed that no one particular pepper is rich in all nutrients, hence the need to consume the pepper as combinations with themselves. The different verities of the composition of phytochemical compounds in this fruits indicate the important in choosing suitable foods that have rich source of antioxidant capacity as prevention to the development of chronic disease such as diabetes and cancer (Shaha *et al*., 2013).

Consumers expect fresh meat products to have a homogeneous reddish-pink color; it has been estimated that 2% to 20% of all meat products are discounted, discarded, or further processed due to discoloration and off-odors (Sherbeck *et al.*, 1995).

Corresponding Author: M.E. Abd-ElGhany, Food Science and Technology Department, Faculty of Agriculture, AL-Azhar University, Cairo, Egypt.
E-mail: maherelsayedali@gmail.com

Beef burger patties are added to the meat products formulation to lower the cost of products (Sharaf *et al*., 2009). The combined use of antioxidants and modified atmosphere packaging for meat represents a realistic and attractive strategy to increase the shelf life of fresh meat (Djenane *et al.*, 2002 and Sanchez-Escalante *et al*., 2003). Polyphenol-rich plants of the *Labiatae* family and many other have been well studied for their antioxidant properties in meat and other foods. Chili peppers (*Capsicum annuum*, *Solanaceae*) are well known all over the world as a delicious spice with characteristic color, taste, and heat (Henderson and Henderson, 1992 and Perucka & Oleszek, 2000).

Martinez *et al*. (2006) studied that the Addition of *Capsicum* peppers (sweet red and hot cayenne) and *Piper* peppers (black and white) powders to fresh pork sausages, and found that this addition led to extension of their shelf life, although to different extents depending on the spice and the concentration used. Replacing or addition of the commonly used traditional extenders or Polyphenol-rich plants will depend on the price, technological, nutritional properties and consumers acceptance of the used replacer (Sian and Ishak, 1991).

Therefore, the current study aimed to evaluate the effect of using Chili pepper powder (CPP) at different concentration (1, 2 and 3%) as phytochemical in formula of beef Burger patties on the chemical, physiochemical, microbiological and sensory characteristics of beef burger patties during frozen storage.

Material and Methods

Materials:

Chili Pepper:

Chili (*Capsicum annum* Linn.) was obtained from the Agriculture Research Center, Giza, Egypt.

Soybean Flour (SF):

Soybean flour containing 48 % protein was obtained from food Technology Research Institute, Agriculture Research Center, Giza, Egypt.

Beef Meat:

Beef meat of binned quarter, obtained from the local butcher shop in the day of burger manufactures was used in this investigation.

Burger Ingredients:

Spices, Fresh eggs, onion and salt (sodium chloride) were obtained from the local market. While, sodium tripolyphosphate, sodium ascorbate and sodium nitrite were obtained from Adwic Laboratory Chemicals Co., Cairo, Egypt.

Microorganisms:

The pathogenic microbes of *Escherichia coli* O157:H7, *Salmonella spp, Staphylococcus aureus, Bacillus cereus, Saccharomyces cervisiae, Candida sake, Aspergillus flavus* and *Aspergillus niger* war selected for studied the antimicrobial activity of CPP ethanolic extracts. These microbes' strains were obtained from Microbiological Resources Centre (Cairo Mircen), Faculty of Agriculture, Ain Shams University, Egypt. These Microorganisms was activated by checked for purity, identity and always generated. The cultures were stored in refrigerator at 4ºC and they were reactivated monthly on the suitable medium.

Methods:

Experiments:

Preparation of pepper Sample:

Chili pepper powder (CPP) (*Capsicum annuum*) was washed, dried (50ºC/ 18h) and mild in powder form, packed in polyethylene pages and stored at cooling conditions till used,as described by (Emmanuel-Ikpeme *et.al*., 2014).

Preparation of Beef Burger Patties:

Beef Burger Formulation:

Beef burger patties control was formulated to contain the following ingredients 62% Lean meat, 12% Soy flower, 7% fresh eggs, 7% fresh onion paste, 1.5% salt, 10% Iced water, 0.5% spices, 0.3% Sodium tripolyphosphate, 0.03% sodium ascorbate and 0.015% Sodium nitrite according to Dreeling *et al.*, (2000) and modified by Oroszvari, *et al*., (2006).the traded patties containing 1,2 and 3% CPP war Also prepared according this methods.

Phytochemical extraction:

Ethanol 95% was used for the phytochemical extraction of dried CPP according to the method described by Loew, (1997).

Determination of antimicrobial activity:

Ethanolic extracts of Chili pepper thus obtained were immediately evaluated for antibacterial using agar well diffusion method and antifungal activities using poisoned food technique (Barreto *et al.,* 2002).

Cooking of Beef Burger Patties:

The patties were grilled for measuring cooking measurements and to sensory evaluate according to Ou and Mittal, (2006).

Analytical Methods:

Beef burger patties were periodically analyzed every month during the frozen storage at-18 ± 2°C for 3 months as follows:

Chemical Analysis:

Proximate composition of moisture (70ºC overnight), protein (N×6.25), ether extract (petroleum ether 40-60/16h), fiber, Ash (550ºCovernight) and carbohydrates by difference war estimated according to A.O.A.C. (2000). Total volatile nitrogen (TVN) content and Thiobarbituric acid (TBA) values war estimated as described by Pearson, (1976).

Physical Analysis:

The pH value for beef burger patties was determined by using a calibrated pH meter (Beckman model 3550, USA) according to Schoeni *et al*., (1991). Water holding capacity (WHC) and plasticity were determined by filter piper press method of Soloviev, (1966). Calculation of cooking loss was determined according to Raharjo *et al*., (1995), while cooking shrinkage was calculated according to Adams, (1994). Also, moisture retention value was determined according to El-Magoli *et al*., (1996). While, fat retention was calculated according to the method described by Murphy *et al.,*(1975).

Microbiological Aspects:

The counts of total bacterial (TBC), psychrophilic bacteria, mold and yeast, coliform bacteria, Salmonella and shigella and Staphylococcus bacteria were determined according to Difco (1984).

Sensory Evaluation:

Sensory evaluation was carried out at zero time and after frozen storage at -18±2°C up to 3 months. Cooked beef burgers were left to cool at room temperature for 15 minutes before being subjected to organoleptic evaluation as described by Basker, (1988).The cooked burger samples were evaluated by twenty panelists of staff members and graduate students of Food science and Technology Department, Faculty of Agriculture, Cairo Al-Azhar University. Panel members were asked to evaluate different cooked burger treatments for color, odor, taste, texture, tenderness, Juiciness and overall acceptability on a 10 point hedonic scale.

Statistical Analysis:

The obtained results were analyzed using analysis of variance (ANOVA) and least significance difference (LSD) at a significance probability 5 % according to Steel and Torrie, (1980).

Results and Discussion

Antimicrobial Activity of Ethanolic Extraction of Chili Pepper Powder:

The growing concern about food safety has recently led to the development of natural antimicrobials to control food borne and spoilage microorganisms. Spices are one of the most commonly used natural antimicrobial agents in foods and have been used traditionally for thousands of years by many cultures for preserving foods and as food additives to enhance aroma and flavor (Nevas *et al.,* 2004 and Souza *et al.,* 2005).

In the present investigation (Table 1), the ethanolic extracts of CPP showed inhibitory activity against the tested food-pathogenic microorganisms in which the diameter of zone of growth inhibition varied between 4 to 16mm. It was lower than those Acetic acid (Positive control), whereas it was between 5 to 23mm. Also the CPP ethnaolic extract showed highest diameter of inhibition zone of 16mm against *E. coli* followed by *Salmonella spp* (15mm) and *Bacillus cereus* (14mm). The minimum inhibitory activity was recorded against *Candida sake* and *Saccharomyces cerevisiae* was negative effect.

On the other hand data in table (1) illustrated that the inhibitory activity of CPP ethanolic extracts was highest value against Gram-negative followed by Gram-positive, fungi and yeasts. The antimicrobial activity of

CPP may be due to the presents of phytochemical compounds which containing polyphenols and antioxidants. Hence they may be considered as natural preservatives without any side effects on human health. While, the ethanol (negative control) showed no any inhibitory activity against the tested food- pathogenic microorganisms. Generally, these results are in agreement with reported by Sulieman *et al*. (2007) and Pundir *et al*., (2010) they demonstrated the antibacterial activity of CPP ethanolic extract against *E. coli, S. aureus* and *B. subtilis*.

Table 1: Antibacterial activity of chili pepper ethanolic extracts against food- pathogenic bacteria by agar well diffusion method.

	Diameter of inhibition zone (mma)							
	Gram-negative		Gram-positive		Fngi		Yeasts	
Plant extract	E- *coli*	*Salmonella spp*	*Staphylococcus aureus*	*Bacillus cereus*	*Aspergillus flavus*	*Aspergillus niger*	*Candida sake*	*Saccharomyces cerevisiae*
CPP	16	15	12	14	10	5	4	-NE
PC	21	23	18	17	13	10	8	5
NC	-	-	-	-	-	-	-	-

- *No activity; Values, including diameter of well (8mm), are means of the three replicate.* ***NE*** *: Negative effect* ***- P(control):*** *Positive control (Acetic acid).****N(control):*** *Negative control (Ethanol).*

Frozen Storage Stability for Quality Criteria of Beef Burgers patties:

A-Gross Chemical Composition of Beef Burgers Containing Chili pepper powder:

The present data in Table 2, illustrated that there was a considerably change in moisture content of beef burger patties containing different concentration 1, 2 and 3% of CPP when compared with the control. The loss of moisture increased (P< 0.05) with increasing the level of CPP concentration. While, a gradual decrease in moisture content of all beef burger samples was observed during frozen storage up to 3 months. The decrement in moisture content might be due to drip loss throughout thawing process and partially evaporation of moisture (Rehab, 2002). Also the increment concentration of Chili pepper powder which lead to increasing the water binding capacity (Sulieman and Amed, 2012 and Zaki *et al.*, 2013).

Table 2: Chemical composition properties of beef burger samples as affected by addition different concentration% of Chili pepper powder (CPP) during frozen storage at - 18±2 °C for 3 months.

Treatments	M±SE			
	control	1%(CPP)	2%(CPP)	3%(CPP)
Storage(month)	moisture			
0	69.65^{a}	68.59^{b}	67.95^{bc}	67.37^{c}
1	69.47^{a}	68.28^{b}	67.61^{bc}	67.19^{c}
2	69.33^{a}	68.03^{b}	67.48^{bc}	66.95^{c}
3	68.96^{a}	67.79^{b}	67.31^{bc}	66.73^{c}
	protein			
0	56.46^{a}	56.58^{a}	56.70^{a}	56.82^{a}
1	55.71^{a}	55.83^{a}	55.94^{a}	56.06^{a}
2	55.01^{a}	55.10^{a}	55.25^{a}	55.37^{a}
3	53.57^{a}	53.69^{a}	53.81^{a}	53.93^{a}
	Ether extracts			
0	16.12^{a}	16.14^{a}	16.16^{a}	16.18^{a}
1	15.55^{a}	15.57^{a}	15.58^{a}	15.60^{a}
2	15.40^{a}	15.41^{a}	15.44^{a}	15.46^{a}
3	15.25^{a}	15.27^{a}	15.29^{a}	15.31^{a}
	Ash			
0	12.32^{a}	12.42^{a}	12.52^{a}	12.62^{a}
1	13.57^{a}	13.67^{a}	13.76^{a}	13.87^{a}
2	13.88^{a}	13.98^{a}	14.08^{a}	14.18^{a}
3	14.03^{a}	14.13^{a}	14.23^{a}	14.33^{a}
	Fiber			
0	0.98^{d}	1.12^{c}	1.26^{b}	1.40^{a}
1	1.04^{d}	1.18^{c}	1.31^{b}	1.45^{a}
2	1.07^{d}	1.20^{c}	1.35^{b}	1.49^{a}
3	1.12^{d}	1.26^{c}	1.40^{b}	1.54^{a}
	Total carbohydrate			
0	14.12^{d}	14.74^{c}	15.36^{b}	15.98^{a}
1	14.13^{d}	14.75^{c}	15.41^{b}	16.02^{a}
2	14.64^{d}	15.31^{c}	15.88^{b}	16.50^{a}
3	16.03^{d}	16.65^{c}	17.27^{b}	17.89^{a}

Means in the same row with different superscripts are different significantly (p< 0.05).Carbohydrate by difference

From Table 2, as the results of CPP addition to beef burger, the protein, ether extract, ash and fiber contents of beef burgers containing CPP obviously increased (P< 0.05) with increasing CPP concentration, as compared with control beef burger sample. Furthermore, a gradual decrease in protein content of all beef burger samples was observed during frozen storage up to 3 months. These decreases might be due to slight loss of nitrogen (as volatile nitrogen) as a result of slight protein breakdown and of leaching the soluble nitrogenous compounds throughout process (Abd-Elkhalik, 2011). While, ash and fiber contents increased with increasing frozen storage time in all burger samples. Also, a negligible increase in ether extract content of these samples was noticed when compared with control sample, these contents were imperceptible decreased during frozen storage periods in all samples. On the other hand, there was a slight alteration in carbohydrate content of all beef burger samples. Generally, the increments in ash, fiber, and carbohydrate contents in all samples during frozen storage might be due to alteration of moisture and protein contents (Abd-Elkhalik, 2011 and Abd-Elghany, 2014) . These results are in close approximately agreement with those reported by Sharaf *et al*., (2009) and Abd-Elghany, (2014).

B-Physicochemical Quality Criteria of Beef Burgers Containing CPP:

Physiochemical quality criteria of beef burger samples such as pH value, WHC, plasticity cm^2/0.3gm total nitrogen, TVN and TBA contents were significantly affected by addition of Chili pepper powder CPP and during frozen storage periods, as shown in Table 3. The addition of CPP in beef burgers formula resulted in a slight increase in the pH values when compared with control sample without any addition. On the other hand, pH value increased continuously in all beef burger patties during frozen storage up to 3 months. The increment rate in this value was lowest in beef burger sample containing CPP at different concentration (1, 2 and 3%). Degradation of beef burgers protein during storage resulting in formation of some basic compounds such as volatile nitrogen compounds, amines and hydrogen sulfide, leading to increase pH value (Ogungbenle, 2003).

Also the same table, illustrated that water holding capacity (WHC) of beef burger sample containing CPP was increased when compared with control sample. During frozen storage, WHC value reduced gradually in all beef burger samples with extending the frozen storage periods as the result of breakdown hydrogen bonding between the water molecules and gross chemical components of beef burgers (Oroszvari, *et al*., 2006). On the other hand, the TBA value of beef burger samples increased gradually during frozen storage, this increase could be mainly attributed to the oxidation of beef burger lipids and formation of some TBA-reactive compounds during the storage period as reported by Stahnke, (1995), Sharaf *et al.,* (2009) and Abd-Elghany, (2014).

Table 3: Physiochemical properties of beef burger samples as affected by addition different concentration% of Chili pepper powder (CPP) during frozen storage at - 18±2 °C for 3 months .

Treatments	M±SE			
	control	1%(CPP)	2%(CPP)	3%(CPP)
Storage(month)	pH			
0	5.98^a	6.11^a	6.15^a	6.23^a
1	6.17^a	6.25^a	6.35^a	6.39^a
2	6.23^a	6.32^a	6.42^a	6.50^a
3	6.53^a	6.44^a	6.51^a	6.62^a
WHC%				
0	82.54^b	82.73^b	83.52^a	84.08^a
1	82.04^c	82.32^c	83.10^b	83.87^a
2	81.62^c	81.95^c	82.65^b	83.39^a
3	80.72^c	81.32^c	82.18^b	82.95^a
Plasticity(c^2/0.3g)				
0	2.65^a	2.59^a	2.47^b	2.38^c
1	2.44^a	2.38^a	2.29^b	2.20^{cb}
2	2.19^a	2.13^a	2.05^b	1.69^c
3	2.07^a	1.98^a	1.78^b	1.49^c
TVN mg/ 100g				
0	5.28^a	5.08^{ab}	4.47^{bc}	4.12^c
1	7.68^a	6.87^b	6.16^c	5.78^c
2	11.07^a	10.52^a	9.75^b	8.85^c
3	13.22^a	12.68^a	11.72^b	11.17^c
TBA mg /kg				
0	0.268^a	0.252^a	0.248^a	0.240^a
1	0.388^a	0.375^a	0.329^b	0.295^c
2	0.587^a	0.552^b	0.515^b	0.475^c
3	0.733^a	0.678^b	0.596^c	0.545^d

Means in the same row with different superscripts are different significantly (p< 0.05).

With regard to plasticity cm^2/0.3gm total nitrogen of beef burger samples containing CPP were lower (P<0.05) than the control. In addition, plasticity decreased linearly for all beef burger samples during frozen storage, but it was more evident in control sample than other samples containing CPP.

The same table, showed that sample containing CPP was higher than control in its content of Total volatile nitrogen (TVN). Furthermore, sample containing CPP was lower than control in its content of thiobarbituric acid (TBA). Moreover, TVN and TBA contents of all beef burger increased continuously during frozen storage up to 3 months. Abd-Elkhalik, 2011, Sharaf et *al*., (2009) and Abd-Elghany, (2014) supported the trend obtained results.

C-Cooking Measurements of Beef Burgers Containing Chili pepper powder:

As shown in Table (4), cooking loss and cooking shrinkage percentages of beef burger samples containing CPP at levels of 1, 2 and 3 % were lower (P<0.05) than the control. On the contrary, this percentages of cooking loss and cooking shrinkage increased with increasing frozen storage time in all burger samples. On the other hand the rate of increase in cooking loss and cooking shrinkage were lower than control sample during storage period. The lowest cooking loss and cooking shrinkage percent of beef burger containing CPP may be attributed mainly to the high water binding capacity of Chili pepper (Emmanuel-Ikpeme *et al*., 2014), while the increment during frozen storage may be due to not only the fluids separated by the thawing of the frozen patty but also the protein denaturation and releasing of fat and water from beef burger patties.

Also, the same table shows that moisture retention and fat retention values of beef burger samples increased (P<0.05) with the increasing concentration of CPP in beef burger samples. However, these values decreased during frozen storage linearly in all samples. which was attributed to the high water and oil binding capacity of Chili pepper (Lopez, 1991 and Ogungbenle *et al.* 2009). Generally the addition of Chili pepper powder at different concentration to the beef burger leaded to a considerable improvement the cooking properties. These results were in accordance with those obtained by Abd-Elkader, (2003) and Abd-Elghany, (2014).

Table 4: Cooking measurements properties of beef burger samples as affected by addition different concentration% of Chili pepper powder (CPP) during frozen storage at - 18±2 °C for 3 months.

Treatments	M±SE			
	control	1%(CPP)	2%(CPP)	3%(CPP)
Storage(month)	Cooking loos %			
0	30.16^a	29.75^a	28.12^b	25.90^c
1	32.53^a	31.11^b	30.65^b	$27,65^c$
2	34.21^a	33.22^a	31.92^b	30.44^b
3	35.40^a	35.06^a	33.87^b	32.72^c
	Cooking Shrinkage %			
0	20.21^a	19.51^{ab}	18.77^{bc}	18.22^c
1	22.50^a	21.95^a	20.86^b	19.89^c
2	23.90^a	23.56^a	22.32^b	20.22^c
3	25.35^a	24.66^{ab}	23.55^{bc}	22.55^c
	Moisture retention%			
0	37.35^b	37.44^{ab}	37.88^{ab}	38.22^a
1	37.22^b	37.31^b	37.65^{ab}	38.09^a
2	36.95^b	37.09^b	37.32^{ab}	73.87^a
3	36.80^b	36.95^{ab}	37.12^{ab}	37.62^a
	Fat retention%			
0	65.22^b	67.68^a	67.89^a	68.22^a
1	65.05^c	67.45^b	67.62^b	68.3^a
2	64.83^c	67.13^b	67.38^{ab}	67.72^a
3	64.57^b	66.78^a	67.05^a	67.45^a

Means in the same row with different superscripts are different significantly (p< 0.05).

D-Microbiological Quality Criteria of Beef Burgers Containing Chili pepper powder:

Table 5, illustrates that the total bacterial (TBC), Psychrophilic bacteria, coliform bacteria group, Staphylococcus bacteria, and mold & yeast counts of beef burger samples containing CPP at different concentration % was decreased as compared to the control, also, the count of microorganisms increased with progressing the storage time, especially for the control. These results are in agreement with those reported by Sharaf *et al*., (2009) and Abd-Elghany (2014).

The CPP addition to beef burger effected on Microbiological quality criteria of beef burger samples at either the initial time or at any frozen storage period. Results indicated that TBC, Psychrophilic bacteria, coliform bacteria group, Staphylococcus bacteria and mold and yeast counts decreased with addition of CPP at the level 1,2 and 3%, furthermore, Staphylococcus bacteria and mold and yeast not found in the sample containing 3% CPP, which may be attributed to the pH (5.2-6.2) of Chili pepper and the reducing of free water resulting from the high water binding capacity of CPP (ZAKI *et al*., 2013 and Emmanuel-Ikpeme *et al*., 2014),.

Moreover, the phytochemical contents in CPP especially polyphenols compounds is antimicrobial, antibiotic, fungistatic, and pharmacological properties (Sulieman *et al*., 2007 and Pundir *et al*., 2010).
On the contrary, the Salmonella & shigella was no found in all samples even after frozen storage period. These results are in quite comparable to those obtained by Sarac and Ugur (2007), Sharaf *et al*., (2009) and Abd-Elghany (2014). Generally, microbial quality criteria of all beef burger samples were within permissible counts reported by E.O.S (2005), which recommend that the total bacterial, coliform group and Staphylococcus bacteria counts not exceed 5, 3 and 3 log Cfu /g, respectively, while, the Salmonella & shigella could be not found.

Table 5: Microbiological counts (log cfu /g) of beef burger samples as affected by addition different concentration% of Chili pepper powder (CPP) during frozen storage at - 18±2 °C for 3 months.

Treatments	Microbiological counts (log cfu /g)			
	Control	1% (CPP)	2% (CPP)	3% (CPP)
Storage(month)	Total bacterial count (TBC)			
0	4.41	4.39	4.37	4.33
1	4.34	4.28	4.22	4.17
2	4.59	4.55	4.44	4.39
3	4.89	4.77	4.64	4.58
Psychrophilic bacteria				
0	2.94	2.92	2.85	2.82
1	3.19	2.95	2.89	2.85
2	3.32	3.25	3.02	2.98
3	3.46	3.42	3.27	3.09
Coliform group				
0	2.50	2.49	2.46	2.34
1	2.38	2.33	2.27	2.21
2	2.69	2.59	2.48	2.39
3	2.79	2.70	2.57	2.48
Mold and yeasts				
0	1.97	1.93	1.81	N.D
1	1.89	1.65	1.32	N.D
2	2.49	2.43	2.27	N.D
3	2.90	2.86	2.65	N.D
Staphylococcus bacteria				
0	1.65	1.60	1.54	ND
1	1.66	1.54	1.50	ND
2	1.89	1.77	1.67	ND
3	1.99	1.88	1.84	ND
Salmonella and shigella				
0	ND	ND	ND	ND
1	ND	ND	ND	ND
2	ND	ND	ND	ND
3	ND	ND	ND	ND

E-Sensory Quality Criteria of Beef Burgers Containing Chili pepper powder:

Beef burger samples containing CPP at levels 1, 2 and 3 % were sensory evaluated and compared to the control sample without any addition as shown in Table 6. Data in table (6), indicated that there were no significant differences among beef burger samples containing CPP at levels (1, 2 and 3%) and control in color, oder and appearance. Also, the same table shows that there were no significant differences among control and samples containing 1 and 2 % CPP in both taste, juiciness, and tenderness , but the samples containing 3 % of CPP were significantly different ($P < 0.05$) as compared with the other samples. With regard to the Overall acceptability, the sample containing 3 % of CPP was the lowest acceptable sample, while the other samples were not significantly different as compared with control.

Sensory evaluation of beef burgers revealed that, beef burgers with 1 and 2 % CPP have the highest level of acceptance for all sensory characteristics, there were no significant differences could be detected among these samples and control, even after frozen storage for 3 months.

Table 6: Sensory evaluation of beef burger samples as affected by addition different concentration% of Chili pepper powder (CPP) during frozen storage at - 18±2 °C for 3 months.

Treatments	M±SE			
	Control	1%(CPP)	2%(CPP)	3%(CPP)
Storage(month)	Color			
0	8.92[a]	8.94[a]	8.95[a]	8.90[a]
1	8.71[a]	8.69[a]	8.70[a]	8.68[a]
2	7.89[a]	8.15[a]	8.18[a]	7.92[a]
3	7.79[a]	7.82[a]	7.86[a]	7.75[a]
Taste				
0	8.81[a]	8.77[a]	8.72[a]	7.29[b]
1	8.52[a]	8.47[a]	8.42[a]	7.03[b]
2	7.82[a]	7.74[a]	7.69[a]	6.74[b]
3	7.85[a]	7.76[a]	7.70[a]	6.30[b]
Odor				
0	8.90[a]	8.50[a]	8.60[a]	8.75[a]
1	8.19[a]	8.22[a]	8.24[a]	8.26[a]
2	8.20[a]	8.08[a]	8.00[a]	8.10[a]
3	7.63[a]	7.66[a]	7.69[a]	7.53[a]
Tenderness				
0	8.76[a]	8.72[a]	8.69[a]	7.30[b]
1	8.50[a]	8.44[a]	8.39[a]	7.11[b]
2	8.33[a]	8.24[a]	8.20[a]	6.89[b]
3	8.20[a]	8.00[a]	7.95[a]	6.54[b]
Juiciness				
0	8.85[a]	8.78[a]	8.69[a]	6.70[b]
1	7.50[a]	7.45[a]	7.39[a]	6.60[b]
2	7.35[a]	7.25[a]	7.19[a]	6.29[b]
3	6.99[a]	7.13[a]	7.20[a]	6.00[b]
Appearance				
0	8.64[a]	8.65[a]	8.70[a]	8.45[a]
1	8.21[a]	8.43[a]	8.49[a]	8.10[a]
2	8.09[a]	8.20[a]	8.34[a]	7.68[a]
3	7.87[a]	7.86[a]	8.00[a]	7.88[a]
Overall acceptability				
0	8.55[a]	8.50[a]	8.82[ab]	7.71[b]
1	8.31[a]	8.28[a]	8.59[ab]	7.69[b]
2	8.00[a]	8.05[a]	8.32[ab]	7.44[b]
3	7.75[a]	7.65[a]	7.76[a]	7.10[b]

Means in the same row with different superscripts are different significantly ($p< 0.05$).

Conclusion and Recommendation

It could be concluded that, the basis of the present finding, it appears that proper adding of high phytochemical plants as Chili pepper to beef burger patties resulted in improving the nutritional, physiochemical, cooking properties, microbiological and sensory quality criteria with lowering the product cost.

References

A.O.A.C., 2000. Official Methods of Analysis. 17th ed. of the association of official analytical chemists. Gaithersburg M.D., USA.

Abd-Elghany, M.E., 2014. Effect of Quinoa seeds meal addition on the quality characteristics of beef Burger patties during frozen storage. J. Biological Chemistry and Environmental Sciences, 9(1):01-20.

Abd-Elkader, M. F., 2003. Quality improvement of Chicken Frozen burger formulated with some spices or volatile oils. M. Sc. Thesis, Food Science and Technology Dept., Faculty of Agric., Cairo Univ., Egypt.

Abd-Elkhalik, R. A., 2011. Chemical and microbiological studies on some chicken meat products. Thesis, Food Science and Technology Dept., Faculty of Agric., Assut Univ., Egypt.

Adams, S.M., 1994. Development of low-fat ground beef patties with extended shelf life. MS. Thesis, Texas A and M University, College Station, TX.

Alvarez-Parrilla, E., Laura A. de la Rosa, R. Amarowicz, and F. Shahidi, 2011. Antioxidant Activity of Fresh and Processed Jalapeño and Serrano Peppers. J. Agric. Food Chem., 2011, 59 (1), pp 163–173

Aniel Kumar, O., S. S. Tata,2009. Ascorbic acid contents in chili peppers (*Capsicum* L.), Not. Sci. Biol., 1(1), 50–52.

Barreto, M., A. T. Critchley and C. J. Straker, 2002. Extracts from seaweeds can promote fungal growth. J. Basic Microbiol., 42, 302-310.

Basker, D., 1988. Critical values of differences among rank sums for multiple compositions. Food Technol., 42: 77, 78, 80, 84.

Difco-Manual,1984. Dehydrated culture media and reagents microbiological and clinical laboratory procedures. Pub. Difco-lab- Detroits Michigan. U.S.A.

Djenane, D., A. Sanchez-Escalante, J.A. Beltrán, and P. Roncalés, 2002. Ability of tocopherol, taurine and rosemary, in combination with vitamin C, to increase theoxidative stability of beef steaks packaged in modified atmospheres. Food Chem76, 407–415.

Dreeling, N., P. Allen and F. Butler, 2000. Effect of the degree of comminution on sensory and texture attributes of low-fat beef burger. LWT-Food Sci. Technol., 33, 290-294.

E.O.S., 2005. Egyptian Organization for Standardization and Quality Control. Frozen beef burger No. 1688.

El-Magoli, S.B., S. Laroiab and P.M.T. Hansed, 1996. Flavor and Texture Characteristics of Low Fat Ground Beef Patties Formulated with Whey Protein Concentrate. Meat Sci., 42, 179-193.

Emmanuel-Ikpeme, C., P. Henry, O. A. Okiri, 2014. Comparative evaluation of the nutritional, phytochemical and microbiological quality of three pepper varieties. Journal of Food and Nutrition Sciences, 2(3): 74-80.

Esayas, K., A. Shimelis, F. Ashebir, B. Tilahun and D. Gulelat, 2011. Proximate composition, Mineral content, and Antinutritional factors of some capsicum (*Capsicum annum*) varieties grown in Ethiopia. Journal of the Korean society of Food Science and Nutrition, 37(8): 1084-1089.

Faustino, J.M.F., Barroca, M.J. and Guine, R.P.F. (2007). *Food Bioproduct Process,* 85: 163-170.

Henderson, D.E. and S.K. Henderson, 1992. Thermal decomposition of capsaicin. I. interactions with oleic acid at high temperatures. J Agric. Food Chem., 40, 2263–2268.

Howard, L. R., S. T. Talcott, C. H. Brenes and B. Villalon, 2000. Changes in phytochemical and antioxidant activity of selected pepper cultivars (*Capsicum* sp.) as influenced by maturity. Journal of Agriculture and Food Chemistry, 48, 1713-1720.

Loew, D., 1997. Is the biopharmaceutical quality adequate for clinic pharmacology? Inter. J. Clinic. Pharmacol. Res., 35: 302-306.

Lopez, O.P., C.O. Falomir and M.R. Vazauez, 1991. Chickpea protein isolates: physiochemical, functional and nutritional characteristics. J. Food Sci., 56, 726.

Marinova, D., F. Ribarova, M. Atanassova, 2005. Total phenolics and total flavonoids in bulgarian fruits and vegetables., J. Univ. Chem. Tech. Metall. 40(3):255-260.

Martinez, L., D. Djenane, I. Cilla, J.A. Beltran, and P. Roncales, 2006. Effect of varying oxygen concentrations on the shelf-life of fresh pork sausages packaged in modified atmospheres. Food Chem., 94,219–225.

Murphy, E.W., P.E. Criner and B.C. Grey, 1975. Comparison of methods for calculating retentions of nutrients in cooked foods. J. Agric. Food Chem., 23, 1153-1157.

Nevas, M., A. R. Korhonen, M. Lindtrom, P. Turkki and H. Korkeala, 2004. Antibacterial efficiency of Finnish spices essential oils against pathogenic and spoilage bacteria. J. Food Prot. 67, 199-202.

Ogungbenle, H., 2003. Nutritional evaluation and functional properties of quinoa (Chenopodium quinoa) flour. Int. J. Food Sci. Nutr., 54, 153–158.

Ogungbenle, H., A. Oshodi and M. Oladimeji, 2009. The proximate and effect of salt applications on some functional properties of quinoa (*Chenopodium quinoa*) flour. Pak. J. Nutr. 8(1): 49–52.

Oroszvari, B.K., E. Bayod, I. Sjohölm and E. Tornberg, 2006. The mechanisms controlling heat and mass transfer on frying beef burgers. III. Mass transfer evolution during frying. J. Food Eng., 76, 169-178.

Ou, D. and G.S. Mittal, 2006. Double-sided pan-frying of unfrozen / frozen hamburgers for microbial safety using modelling and simulation. Food Res. Intl., 39, 133-144.

Pearson, S., 1976. Chemical analysis of food. 8th Ed. Harold Egan, Ronald S. Kirk Roland Saweyer (London).

Perucka, I. and W. Oleszek, 2000. Extraction and determination of capsaicinoids in fruit of hot pepper *Capsicum annuum* L. by spectrophotometry and high-performance liquid chromatography. Food Chem 71, 287–291.

Pundir, R. K., J. Pranay, and S. Chetan, 2010. Antimicrobial Activity of Ethanolic Extracts of *Syzygium aromaticum* and *Allium sativum* Against Food Associated Bacteria and Fungi. Ethnobotanical Leaflets, 14, 344-360.

Raharjo, S., D. R. Dexter, R. C. Worfe, J. N. Sofos, M. B. Solomon, G.W. Shults, and G.R. Schmidt, 1995. Quality characteristics of restructured beef steak manufactured by various techniques. J. Food Sci., 60, 68-71.

Rehab, M.M., 2002. Effect of some food additives on the shelf-life of refrigerated beef meet. Ph.D. Thesis, Food Science and Technology Dept., Faculty of Agric., Cairo Univ.

Roncales P., 2003. Antioxidant action of borage, rosemary, oregano, and ascorbic acid in beef patties packaged in modified atmosphere. J Food Sci 68, 339–344.

Sanchez-Escalante, A., D. Djenane, G. Torrescano, J.A. Beltrán and N.K. Sian, and S. Ishak, 1991. Effect of pH on formation, proximate composition and rehydration capacity of bean and soybean protein-Lipid film. J. Food Sci., 55, 261-268.

Sarac, N. and A. Ugur, 2007. Antimicrobial activity and usage in folkey. Eur Asia J. BioSci., 4, 28-37.

Schoeni, J.L., K. Brunner and M.P. Doylle, 1991. Rates of thermal inactivation of Listeria monocytogenes in beef and fermented beaker sausage. J. Food Protection, 54, 334-337.

Shaha, R.K., R. Shafiqur, and A. Afandi, 2013. Bioactive compounds in chilli peppers (*Capsicum annuum* L.) at various ripening (green, yellow and red) stages. Annals of Biological Research, 2013, 4 (8):27-34.

Sharaf, A.M., M. E. Ebrahium, M. S. Ammar and M.E. Abd El-Ghany, 2009. Influence of Using Moringa Meal Flour as Meat Extender on Quality Characteristics of Beef Burger Patties During Frozen Storage. World Journal of Dairy & Food Sciences 4 (1): 32-40.

Sherbeck, J.A., D. M. Wulf, J. B. Morgan, J. D. Tatum, G.C. Smith, and S.N. Williams, 1995. Dietary supplementation of vitamin E to feedlot cattle affect beef retail display properties. J Food Sci., 60, 250–260.

Sian, N.K. and S. Ishak, 1991. Carotenoid and Anthocyanin Contents of Papaya and Pineapple: Influence of Blanching and Predrying Treatments. Food Chemistry, 39, 175-185.

Soloviev, A.A., 1966. Meat aging In "Food Industry" Pub. (Moscow) 53-81, 82-164, 242-303.

Souza, E. L., T. L. M. Stamford, E. O. Lima, V. N. Trajano and J. B. Filho, 2005. Antimicrobial effectiveness of spices: an approach for use in food conservation systems. Braz. Arch. Biol. Technol. 48, 549-558.

Stahnke, L.H., 1995. Dried sausage fermented with Staphylococcus xylosus at different ingredient levels Part I. Chemical and bacteriological data. Meat Science, 41, 179-191.

Steel, R.G. and J.H. Torrie, 1980. Principles and procedure of statistics analysis. Biometrical approach. 2nd ed. MC Graw-Hill Book Co. INC New York, N.Y.

Sulieman, A. M. E., I. M. O. El-Boshra and E. A. El-Khalifa, 2007. Nutritive value of Clove (*Syzygium aromaticum*) detection of antimicrobial effect of its bud oil. Res. J. Microbiol., 2: 266-271.

Sulieman, H. M. A. and A. A. Allaahmed, 2012. Effect of Antimicrobial Properties of Pepper Fruits on Some Spoilage Organism of Sudanese Wet-Salted Fermented Fish (Fassiekh) Product. World's Vet. J., 2(1): 05-10.

Zaki, N., H. Abdelmalek, O. Aaziz, and P.F. Juan, 2013. Quality characteristics of Moroccan sweet paprika (*Capsicum annuum* L.) at different sampling times. Food Science and Technology, 33(3): 577-585.

Zhuang, Y.L., L. Chen and J. Cao, 2012. Bioactive characteristics and antioxidant activities of nine peppers. Journal of Functional Foods.4(1): 331-338.