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Antioxidant and Antibacterial Activities of Beef Burger by Using Kiwi Fruits Peel Powder

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Abstract

The purpose of this work to examinesthe antioxidant and antibacterial activities of beef burger by using kiwi fruitspeelpowder (KPP) throughout twelvedays of cold storage. Beef burger prepared with adding KPP in three different concentrations 1%,3% and 5%. Sensory attributes was evaluated of cooked beef burger. The mostacceptable product is the one that has been analyzed. Changes of moisture, ash, fat, protein and crude fiber were determined during different time of storage inuncooked beef burger. The antioxidant activity (radical scavenging DPPH), total phenolic content,peroxide value and pH value were determined.Color stability was also evaluated. The effect of kiwifruitspeelpowder (KPP) on total bacterial countat three different concentrations of uncookedbeef burger was also studiedat different time of storage. The results observed that the most acceptablelevel for beef burger with kiwi fruitspeelpowder (KPP)was 5% KPP.The values of protein, moisture, ash, fat, crude fiber and carbohydrates ofkiwi fruitspeelpowder were found to be 6.86±0.09, 3.45±0.13, 7.76±0.22, 0.86±0.09,8.05±0.02 and 73.02±0.05%, respectively.It is observed that the addition of 5% kiwi fruitspeel powder to beef burger led to increase its content of protein and fiber while the values of moisturedecreased, and led to lowerperoxide values than control at 8-day and 12-day.Also, the resultsshowed that the higher antioxidant activity of kiwi fruitspeel powder is due to the higher content of phenolic compounds.The addition of kiwifruits peel powder as natural antioxidant on beef burger improved the oxidative stability and reduces the bacterial growth.This study confirmed that kiwifruitspeel powder could provide as potential sources of natural antioxidants and antibacterial properties, so it can be used safely in meat products industry.

Key words: Kiwifruits peel; Antioxidant activities; Total phenolic ; Chemical composition; Beef Burger; Peroxide value; pH value; Antibacterial properties.

1. Introduction

Lipid oxidation is one of the main factors that affect the quality of meat and meat products; it defines the shelf life of products in that it generates undesirable effects from the sensory and nutritional points of view, and it results in the formation of toxic substances **(Stefanello *et al.*, 2015).**Rapid damage to meat occurs due to microbial growthand lipid oxidation **(Becker *et al.*, 2004).**Low quality burgersduring storage attributed to oxidation of lipid and proteins**(Comi *et al.*, 2015).**Enhance the shelf life of meat can achieve by decreasing microbial growth and delay oxidation of lipid and protein during storage**(Becker *et al.*, 2004).**

Artificial preservatives are used to stop microbial growth and delay the occurrence of oxidation in meat. They have harmful side effects on health as cell death and cancer**(Giatrakou and Savvaidis 2012).**Natural preservatives are preferably used to stop the growth of bacteria and act as an antioxidant to prolonging the life span of meat products and controlling of fat oxidation and have no side effects on health**(Becker *et al.*, 2004).**Consumers are increasing in demand for food products that carry green labels that contain natural antioxidants such as fruits, plants, vegetables, spices, oil seeds, cereals and honey**(Yamazaki *et al.*, 2010)**

Sensory and nutritional properties of kiwi fruit (*Actinidia deliciosa*), which have high concentrations of bioactive compounds, minerals and fiber and increase antioxidant activity resulted in became popular worldwide, these properties slow downreactions of lipid oxidation, the phytochemicals act as prevent formation of free radicals or as scavengers of free radicals**(Shui and Leong, 2006).**

Large quantities of waste are produced from industrial processing of vegetables and fruits and these by-products can be used efficiently **(Schieber *et al.*, 2001)**,to prevent pollution to the environment**(Shalini and Gupta, 2010).Duda-Chodak and Tarko (2007)**reported that fruits wastes are veryrich in bioactive components, which are represented a positive effect on health. There are several products on the market based on kiwi fruit such as juices, pulp, ice cream and jellies; this manufacturing generates waste.Waste from kiwi fruit could be used as food ingredients which are rich in fiber, minerals, phenolic compounds, vitamin C and otherPhytochemicals**(Tavarini*et al.*, 2008)**.Therefore, this study aims to evaluate the antioxidant activities and antibacterialproperties of beef burgerusingkiwi peelpowder during cold storage for 12 days.

2. Material And Methods

2.1. Materials and chemicals

Five kg of fresh beefwere obtained from butcher in Smoha,Alexandria city, Egypt. Meat was minced and used for preparing beef burger.Onion, garlic, salt, spices andkiwi fruits were purchased from a local market at Alexandria city. Egypt.All chemicals and reagents were purchased from Sigma Chemical Co., (USA), Al-Gomhoria Co. for Chemicals (Egypt) and Aldrich Chemical Co. (Steinheim, Germany).

2.2. Methods

2.2.1. Preparation of kiwi fruits peelpowder

Kiwi fruits were carefully washed with distilled water. Peelswere removed and sliced into small pieces, then were oven-dried at 35 ± 5 °C for 72 h according to **Soquetta *et al.* (2016)**, then ground into fine powder and used for the study.

2.2.2. Beefburger preparation

The components of beef burger which have been used were tabulated in Table (1) according to the method of **Jiménez-Colmenero (2007).** The prepared beef burgers were divided into four groups, the first without any additives as a control sample, kiwi fruitspeel powder (KPP) was added to the second, third and fourth beef burger sample at the level of1, 3 and5%, respectively, and mixed well. The beef burgers were prepared using manual-burger machine(10 cm diameter, 65 g weight and 1.3 cm height for each slide). Part of beef burger was maintained under refrigeration at 4^{o}C for 12 days for chemical and antimicrobial analysis, while the other part was cooked to sensory evaluation.

Table 1: Beef burgercomponents with different levels of kiwi fruitspeel powder (KPP)

Ingredients	Weight(g)			
	Beef Burger			
	Control	1% KPP	3%KPP	5%KPP
Minced meat	226.875	226.875	226.875	226.875
Onion juice	1.25	1.25	1.25	1.25
Garlic	0.625	0.625	0.625	0.625
Salt	5.00	5.00	5.00	5.00
Spices	3.75	3.75	3.75	3.75
Ice water	12.5	12.5	12.5	12.5
Total	250	250	250	250
KPP	-	1	3	5

2.2.3. Sensory evaluation

Sensory attributes of cooked beef burgers were evaluated for appearance, texture, color,taste,overall acceptabilityandflavourusing 10-point descriptive scalesaccording to **Kassem and Emara(2010)** to select the highest acceptability score in samples by 15 persons from staff of Faculty of Home Economics, Menoufia University, Shebin El-Kom, Egypt.

2.2.4. Chemical analysis

Protein, fat, moisture, ash and crude fiber of uncooked control beef burger and beef burger using kiwi fruitspeel powder (5% KPP),which had the best sensory properties at different time of storage (4, 8 and 12 days) ,were measuredaccording to**AOAC (2005)**. The carbohydrate content was calculated by subtraction method.

2.2.5. Total phenolic contentandantioxidant activity

Total phenolic contentand antioxidant activity of uncooked control beef burger and beef burger mixed with 5% kiwi fruitspeel powder (5% KPP)were determined at different time of storage (4, 8 and 12 days)according to the Folin-Ciocalteu methodby **Dewantoo *et al.*(2002)** and DPPH method by**Parvin*et al*. (2009)**, respectively.

2.2.6. pH determination

pH value of uncooked control beef burger and beef burger mixed with5%kiwi fruitspeel powder (5% KPP)at different time of storage (4, 8 and 12 days) were measured according to **AOAC (2000).**

2.2.7. Peroxide value determination

Peroxide value of uncooked control beef burger and beef burger mixed with5%kiwi fruitspeel powder (5% KPP)at different time of storage (4, 8 and 12 days) were measured according to AOAC (2000).

2.2.8. Determination of color

Color attributes of uncooked control beef burger and beef burger using 5% kiwi fruitspeel powder (5% KPP)at first day and last day of storage periodwere measured by lightness (L*), redness (a*) and

yellowness (b*) method according to**Hunter and Harold (1987)**, using a HunterlabColorimeter.

2.2.9. Microbiological analysis

Total bacterial countsof uncooked control beef burger and beef burger mixed with kiwi fruitspeel powder (KPP) at three different levels (1, 3 and5 %) were determinedat different time of storage (4, 8 and 12 days).All samples were serially diluted by peptone water. The total counts were carried out on PCA,plate count agar. Plates were incubated at 30^{o}C for 72 h according to **ISO4833-1 (2013).**Counts were reported as log 10 CFU per gram of ground beef.

2.2.10. Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0.(Armonk, NY: IBM Corp). Quantitative data were described using mean, standard deviation. Significance of the obtained results was judged at the 5% level.

The used tests were

1 - Student t-test

For normally distributed quantitative variables, to compare between two studied groups.

2 - F-test (ANOVA)

For normally distributed quantitative variables, to compare between more than two groups, and Post Hoc test (LSD) for pairwise comparisons.

3. Results And Discussion

3.1. Sensory evaluation

Sensory attributes of cooked beef burger as affected by adding different levels ofkiwifruitspeel powder (KPP) are shown in Table (2). The results showed that samples mixed with 5% KPP has the highest score of all attributes including appearance, colour, taste, texture, flavour and overall acceptability as compared with other samples. The obtained results matched with **Kumar *et al.* (2015)**which reported that there are various natural antioxidants have a positive effect on sensory properties and color of meat products.

Table 2: Sensory evaluation of control beef burger and beef burgers mixed with three different level ofkiwi fruitspeel powder (KPP)

Sensory attributes	Beef burger				F	p	LSD
	Control	1% KPP	3% KPP	5% KPP			
Appearance	$8.7^{a}\pm 0.5$	$7.1^{c}\pm 1.1$	$7.7^{cb}\pm 0.8$	$7.9^{b}\pm 0.8$	8.630^{*}	$<0.001^{*}$	0.609
Taste	$8.7^{a}\pm 0.5$	$7.5^{b}\pm 0.9$	$7.6^{b}\pm 0.5$	$7.9^{b}\pm 0.6$	11.343^{*}	$<0.001^{*}$	0.479
Color	$8.5^{a}\pm 0.5$	$7.3^{c}\pm 0.7$	$7.9^{b}\pm 0.5$	$7.8^{b}\pm 0.7$	9.737^{*}	$<0.001^{*}$	0.446
Odor	$8.8^{a}\pm 0.4$	$7.1^{c}\pm 0.6$	$7.3^{c}\pm 0.5$	$7.7^{b}\pm 0.6$	31.271^{*}	$<0.001^{*}$	0.386
Texture	$8.4^{a}\pm 0.5$	$7.2^{c}\pm 0.8$	$7.4^{cb}\pm 0.5$	$7.7^{b}\pm 0.6$	11.057^{*}	$<0.001^{*}$	0.447
Overall acceptability	$8.9^{a}\pm 0.6$	$7^{c}\pm 0.8$	$7.2^{c}\pm 0.4$	$8.1^{b}\pm 0.8$	27.179^{*}	$<0.001^{*}$	0.482
Total score	$52^{a}\pm 1.2$	$43.1^{d}\pm 1.8$	$45.1^{c}\pm 1.2$	$47.1^{b}\pm 1$	123.294^{*}	$<0.001^{*}$	0.969

F: **F for ANOVA test**, Pairwise comparison bet. each 2 groups were done using **Post Hoc Test (LSD)**

*: Statistically significant at $p \leq 0.05$

Means in the same **raw** with **common letters** are not significant

3.2. Chemical composition

Chemical composition of kiwi fruitspeel powder is shown in Table (3). The values of protein, moisture, ash, fat,crude fiber and carbohydrates were found to be 6.86±0.09, 3.45±0.13, 7.76±0.22, 0.86±0.09,8.05±0.02and 73.02±0.05%, respectively.**Soquetta *et al.* (2016)** observed that the flours of kiwi fruit skin and kiwi fruit bagasse had moisture levels between 8.72% and 11.12% and the values of proteinranged from 3.84% to 8.31% for two varieties, mentioned that there are many factors resulted in significantly different values of humidity such as the parts of the fruit, various varieties and ripening stages. The results of lipid in kiwi peel powder is consistentwith **Soquetta e*t al.* (2016)** who found the values of lipid in flours of kiwi fruit bagasse and kiwi fruit skin were ranged from 0.64% to 16.10% of two varieties.

Table 3: Chemical composition (%) of kiwi fruits peel powder (KPP)

Sample	Chemical composition (%)						
	Moisture	Protein	Fat	Ash	Crude fiber	Carbohydrates	Calories
KPP	3.45± 0.13	6.86±0.09	0.86±0.09	7.76±0.22	8.05±0.02	73.02±0.05	327.23±1.20

Values are mean of three replicates ± SD

Changes in chemical composition of control beef burger and beef burger mixed with5%kiwi fruitspeel powder (5%KPP) at different time of storage for 12 days is shown in Table (4).Data showed that the higher moisture content found in control beef burger recorded range from 65.1 ± 0.9 to 66.5 ± 0.2%,and62.8 ± 0.4 to 64.8 ± 0.2% for beef burgerwith 5%KPP, Protein content showed significant difference between control beef burger sampleand beef burger sample with5%KPP(ranged from 17.6 ± 0.4 to18 ± 0.4 %and 21.4 ± 0.2to21.7± 0.2 %, respectively). Fat content ranged between 6.7 ± 0.5 and 7.3 ± 0.2% in control beef burger and 6.8 ± 0.1 to 6.9 ± 0.3% in beef burger with 5%KPP, respectively. The mean of ash content recorded ranged from 2.2 ± 0.2 to 2.3 ± 0.2 % in control beef burger, while ash content in beef burger with 5% KPPranged from2.5 ± 0.1 to 2.9 ± 0.2%.

Table 4: Changes in chemical composition (%) of control beef burger and beef burger mixed with 5%kiwi fruits peelpowder at different time of storage for 12 days

Chemical composition	Percentages (%) of control beef burger				Percentages (%) of beef burger with 5% KPP			
	Storage period (day)				Storage period (day)			
	0	4	8	12	0	4	8	12
Moisture	66.5 ± 0.2	65.6 ± 1.7	65.4 ± 0.7	65.1 ± 0.9	64.8 ± 0.2	63.9 ± 0.4	63.2 ± 0.3	62.8 ± 0.4
t(p)					10.999* (<0.001*)	1.779 (0.150)	4.738* (0.009*)	4.019* (0.016*)
Protein	18 ± 0.2	17.8 ± 1.8	18 ± 0.4	17.6 ± 0.4	21.4 ± 0.2	21.6 ± 0.3	21.6 ± 0.4	21.7 ± 0.2
t(p)					21.999* (<0.001*)	3.714* (0.021*)	10.778* (<0.001*)	17.030* (<0.001*)
Fat	7.3 ± 0.2	7.1 ± 0.4	6.9 ± 0.5	6.7 ± 0.5	6.9 ± 0.2	6.9 ± 0.3	6.8 ± 0.1	6.8 ± 0.1
t(p)					2.588 (0.061)	0.964 (0.389)	0.449 (0.676)	0.204 (0.848)
Ash	2.3 ± 0.2	2.3 ± 0.2	2.2 ± 0.3	2.2 ± 0.2	2.9 ± 0.2	2.9 ± 0.2	2.7 ± 0.2	2.5 ± 0.1
t(p)					3.882* (0.018*)	4.052* (0.015*)	2.578 (0.061)	2.160 (0.097)
Crude fiber	1.4 ± 0.2	1.4 ± 0.1	1.3 ± 0.2	1.3 ± 0.1	2.1 ± 0.2	2.1 ± 0.1	1.9 ± 0.2	2 ± 0.1
t(p)					4.529* (0.011*)	8.074* (0.001*)	3.654* (0.022*)	7.658* (0.002*)

Carbohydrates	4.5 ± 1	5.8 ± 3.3	6.2 ± 1.6	7 ± 0.5	1.9 ± 1	2.7 ± 0.3	3.8 ± 0.6	4.2 ± 0.2
t(p)					3.352* (0.029*)	1.619 (0.244)	2.425 (0.072)	10.062* (0.001*)
Calories	155.7±1.3	158.4±6.6	158.7±0.6	159.3±5.4	155.3±1.3	158.9±2.6	162.5±0.5	165.1±1.3
t(p)					0.368 (0.731)	0.104 (0.922)	8.092* (0.001*)	1.807 (0.145)

t: **Student t-test**
p: p value for comparing between the studied groups
*: Statistically significant at $p \leq 0.05$

The values of crude fiber ranged from 1.3 ± 0.1to 1.4 ± 0.2 % in control beef burger, while in beef burger with 5%KPP was found to be 1.9 ± 0.2to 2.1 ± 0.2%.The table showed that there is a significant differencebetween control beef burger and beef burger mixed with 5% KPP in moisture contentat 0-day, 8-day and 12-day.There are significant differencesbetween control beef burger and beef burger mixed with 5% KPP in protein and crude fiber contentsat 0-day, 4-day, 8-day and 12-day.There is a significant differencebetween control beef burger and beef burger mixed with 5% KPP in ash contentat 0-day and 4-day.There areno significant differences between control beef burger and beef burger mixed with 5% KPP in fat content at different time of storage. It is clear from the table that the addition of 5%kiwi fruits peel powder to beef burger enhanced its content of protein and fiber while the values of moisture decreased.The little reduction of fat content by increasing the storage periods may due to the activity of fat hydrolyzed enzymes or oxidative enzymes**(Muela *et al.*, 2010).**The obtained results of fat are in agreement with **Ramadan *et al.* (2011)**whomentioned that fat content should not exceed than 30% in meat products.**Ethur *et al.* (2010)**reported that in order to prolong the product time should be reduced moisture content because it reduced the growth of living organisms by decreasing the available water for interaction.

3.3. Total phenolic content and antioxidants activity of kiwi fruits peel powder and beef burger samples

Total phenolic content and antioxidants activity of kiwi fruits peel powder (KPP) were tabulated in Table (5). Total phenolic content and DPPH scavenging activity of kiwi fruits peel powder were found to be 180.42 ±0.1mg GAE /100 gand 90.24±0.1%, respectively. The total

phenolic value of kiwi fruits peel powder is lower than the values in previous report by **Bernardes *et al.* (2011)**who indicated the values of flours were1273.41 and 981.87 mg GAE/100g of kiwi fruit skin and pulp, respectively.Changes in total phenolic content and DPPH scavenging activity of control beef burger and beef burger mixed with 5% kiwi fruits peel powder at different time of storage for 12 days is shown in Table (6). The values of total phenolic content found to be from 15.6 ± 0.6 to 17.5 ± 0.2mg GAE/100 g in control beef burger, while ranged from 16.4 ± 0.2to18.6 ± 0.2mg GAE/100 g in beef burger with 5%KPP. The values of DPPH in control beef burger were found to be27.6 ± 0.1to 45.8 ± 0.2% and ranged between38.2 ± 0.2and48.6 ± 0.2 %in beef burger with 5%KPP.

It is clearly from the table that the increasing in storage period was in the same line with the decreasing of total phenolic content and DPPH scavenging activity in control beef burger and beef burger with 5%KPP.It is observedthat the incorporation of 5%KPP to beef burger significantly ($p \leq 0.05$)increasedDPPHscavenging activity at 0-day, 4-day, 8-day and 12-day and also significantly ($p \leq 0.05$) increased the content of total phenolicat0-day, 4-day and 8-day. There are many different factors can influence on total phenolic content like soil of plant, growth of plant, extraction process and the type of solvent to identify compounds**(Madsen and Bertelsen, 1995).Prasad *et al*. (2010**) confirmed that pulp and seed contains less antioxidant than peel. Also, **Meda *et al.* (2005)**mentioned thatsome fruitspeels have stronger antioxidants than seeds due to higher content of flavonoids and polyphenols.

The powder made from kiwi peel had strong antioxidant activity.This result supported by **Melo *et al*. (2008)** who mentioned that the value of DPPH to any compound higher than 70% is considered to have a strong antioxidant capacity.**Ayala-Zavala *et al.* (2004)** reported that there are many factors affected on antioxidant activity such as the degradation of compounds throughout the processing to get the flour, extraction methodologies and varieties different. **Ding*et al*.(2007)**confirmed that the presence of polyphenols and phytochemicals correlatedwith antioxidant activity.Change ofphenols content in kiwifruits throughout storage depended on fruitsmaturity at harvesting time**(Tavarini *et al*., 2008).**

Table 5: **Total phenolic content and DPPH scavenging activity of kiwi fruitspeel powder**

Sample	Total phenolic content (mg GAE /100 g)	DPPH scavenging activity (%)
Kiwi fruits peel powder	180.42±0.1	90.24±0.1

Values are mean of three replicates ± SD

Table 6: Changes in total phenolic content (TPC) and DPPH scavenging activity of control beef burger and beef burger mixed with 5 %kiwi fruitspeel powder (5%KPP) at different time of storage for 12 days

	Control beef burger				**Beef burger with 5%KPP**			
	Storage period (day)				**Storage period (day)**			
	0	**4**	**8**	**12**	**0**	**4**	**8**	**12**
TPC (mg GAE/100 g)	17.5 ± 0.2	17 ± 0.2	16.4 ± 0.2	15.6 ± 0.6	18.6 ± 0.2	18.2 ± 0.1	17.1 ± 0.1	16.4 ± 0.2
t(p)					7.117* (0.002*)	11.038* (<0.001*)	6.630* (0.003*)	2.172 (0.096)
DPPH (%)	45.8 ± 0.2	42.1 ± 0.3	35.6 ± 0.2	27.6 ± 0.1	48.6 ± 0.2	45.2 ± 0.2	39.4 ± 0.2	38.2 ± 0.2
t(p)					18.116* (<0.001*)	14.786* (<0.001*)	24.057* (<0.001*)	87.975* (<0.001*)

t: **Student t-test**
p: p value for comparing between the studied groups
*: Statistically significant at $p \leq 0.05$

3.4. Changes in pH and peroxide value

Changes in pH and peroxide value of control beef burger and beef burger mixed with 5% kiwifruits peel powder at different time of storage for 12 days tabulated in Table (7). pH values ranged between 4.9 ± 0.5and6.4 ± 0.2in control beef burger and 5.2 ±0.1 to 6.2 ± 0.2in beef burger with 5%KPP. It is clearly from the tablethat pH values were decreased by increasing storage time. There are no significant differences between control beef burger and beef burger with 5%KPP in pH valuesat different time of storage. It is observed that acid production was higher in control beef burger that might attribute to lactic acid bacteria in higher growth rate. This result consistent with the previous

report by **Soltanizadeh and Ghiasi-Esfahani (2015)** concluded that the burger samples treated with plant extract doesn't decrease in pH value as compared with untreated burger samples.

Soriyi *et al.* (2008) indicated that the pH values were ranged from 6.50 to 6.90 of different samples of meat and this is within the normal for meat (5.6-7.0). **Choi *et al.* (2007)** mentioned that the pH of meat products generally decreased during storage. **Rubio *et al.* (2007)** reported that there are two factors can influence on the decrease of pH, storage time and refrigerated storage attributed to dissolution of CO2 and lactic acid bacteria activities into the pork patties.**Joseph *et al.* (2014)**found that a decreased in the pH values in all treatments during refrigerated storage of pork with tomato products and pink guava pulp, which can be explained by the formation of compounds due to exogenous and endogenous activities in the product or production of lactic acid from bacteria activities.

Peroxide values ranged from13.6 ± 0.2to 54.2 ± 0.2meq O_2/ kg in control beef burger and ranged between 13.5 ± 0.2and51.4 ± 0.1meq O_2/ kg in beef burger with 5%KPP.There aresignificant ($p \leq 0.05$) differencesbetween control beef burgerand beef burger with 5%KPPin peroxide value at 4-day, 8-day and 12-day. It is clearly from the tablethat PV values increased during the storageperiod.The addition of 5% KPPto beef burger led to significantly ($p \leq 0.05$) lower peroxide values than controlat 8-day and 12-day.This may have contributedto presence of antioxidants and phenolic compounds in kiwi fruits peel powder. **Yi*et al.* (2013)** indicated that the ability to formation of peroxide is related to meat quality as it protein crosses linking and off-flavor formation to provide tougher meat, antioxidants can prevent peroxide formation.**Davies *et al.* (1995)** reported thatthe presence of oxygen caused damage in protein by free radicals resulted in long-lived protein peroxides.

Table 7: Changes in pH value and peroxide value (PV) of control beef burger and beef burger mixed with 5%kiwi fruits peelpowder at different time of storage for 12 days

	Control beef burger				Beef burger with 5%KPP			
	Storage period (day)				Storage period (day)			
	0	4	8	12	0	4	8	12
pH value	6.4 ± 0.2	5.9 ± 0.2	5.4 ± 0.2	4.9 ± 0.5	6.2 ± 0.2	5.6 ± 0.1	5.4 ± 0.1	5.2 ± 0.1
t(p)					1.294 (0.265)	2.185 (0.094)	0.399 (0.711)	0.854 (0.480)
PV(meq O_2/ kg fat)	13.6 ± 0.2	18.5 ± 0.2	29.6 ± 0.2	54.2 ± 0.2	13.5 ± 0.2	19.3 ± 0.1	28.1 ± 0.5	51.4 ± 0.1
t(p)					0.647 (0.553)	5.989* (0.004*)	5.237* (0.006*)	27.329* (<0.001*)

t: **Student t-test**
p: p value for comparing between the studied groups
*: Statistically significant at $p \leq 0.05$

Velasco and Williams (2011) confirmed that there are relation between total phenolic compound content and antioxidant capacity of some methanolic plant extracts and their effects on meat quality during 7-d refrigeration.**Negi and Jayaprakasha(2003)**confirmed that the antioxidant activity with phenolic content inhibited lipid oxidation via blocking radical chain reaction. Also, **Kumar*et al.* (2015)** indicated that antioxidants from natural sources with high phenolics and other active ingredients be able toefficiently prevent start of protein oxidation reactions.**Reeder and Wilson, (2001)** concluded that the stability of peroxides might change with lower the value of ph.Also, **Hwang *et al.* (2011)** confirmed that lipid oxidation was suppressed via the antioxidant effects linked to flavonoidand phenolic compounds.

3.5. Color stability

Effect of addition 5% kiwi fruits peel powder (KKP)tobeef burger on lightness($L*$), redness($a*$) and yellowness($b*$) valuesat first day and last day of storage periodtabulated in Table(8) and (9).The tables show that there are significant ($p \leq 0.05$)differences in color parameters between controlbeef burger and beef burger with5%KPP at first day and last day of storage.Beef burgerincorporated with 5% kiwi

fruits peel powdershowed loweramounts of L*, a*and b* than controlbeef burgerat 1-dayand12-day.The increase of antioxidant activity in kiwi fruits peel powderis able to enhance color stability.**Carpenter *et al.* (2007)** concluded that a significant reduce in $a*$ values of raw pork patties mixed with bearberry and grape seed extract during storage for 12-day.**Zhang *et al.* (2016)** mentioned that myoglobin pigment in meat is changed to oxymyoglobin (light pink color), which could result in brighter red meat and this compound is oxidized to metmyoglobin which affects the color of meat products during storage.Overall color values such as b*, L*and a* , chroma andhue reduced after cold storage for all harvesting stages of kiwi fruits comparedwith fresh kiwi fruits**(Krugera *et al.*, 2010).Rubio *et al.* (2008)** mentioned thatincrease in yellowness (b*)probably due to rancidity.

Table 8: Effect of addition 5%kiwi fruitspeel powder (5% KKP) on $L*$, $a*$, $b*$ values of beef burger at first day of storage

	Control beef burger			**Beef burger with 5% KPP**		
	Storage period (day)			**Storage period (day)**		
	1			**1**		
	L	**a**	**b**	**L**	**a**	**b**
Color parameters	48.41 ± 0.04	10.19 ± 0.07	18.83 ± 0.03	46.03 ± 0.06	6.92 ± 0.10	17.62 ± 0.14
t(p)				58.608* (<0.001*)	46.709* (<0.001*)	14.271* (<0.001*)

t: **Student t-test**
p: p value for comparing between the studied groups
*: Statistically significant at p ≤ 0.05
L=Light vs. dark (Lightness).
a=Red vs. green where a positive number indicates red and a negative number indicates green.
b=Yellow vs. blue where a positive number indicates yellow and a negative number indicates blue

Table 9: Effect of addition 5%kiwi fruitspeel powder (5% KKP) on *L*, a*, b values of beef burger at last day of storage**

	Control beef burger			Beef burger with 5% KPP		
	Storage period(day)			Storage period(day)		
	12			12		
	L	a	b	L	a	b
Color parameters	46.35 ± 0.24	7.16 ± 0.07	18.62 ± 0.17	40.67 ± 0.02	6.47 ± 0.07	17.49 ± 0.10
t(p)				41.171* (0.001*)	11.569* (<0.001*)	10.249* (0.001*)

t: **Student t-test**
p: p value for comparing between the studied groups
*: Statistically significant at p ≤ 0.05
L=Light vs. dark (Lightness).
a=Red vs. green where a positive number indicates red and a negative number indicates green.
b=Yellow vs. blue where a positive number indicates yellow and a negative number indicates blue

3.6. Microbiological evaluation

Effect of kiwi fruits peel powder (KPP) in three different concentrations on total bacterial counts in beef burgers at different time of storage for 12 days are shown in Table (10). Permissible limit should not exceed 10^6 CFU/g according to **Food Administration (1995)**, and 10^5 CFU/g according to **EOS (2005).** Table show that total bacterial counts in control beef burgerranged from $2.9\times10^5\pm$ 0.20to $8.5\times10^4\pm$0.21 CFU/g. Total bacterial counts in beef burger mixed with three different concentrations of kiwi fruits peel powder (1, 3and 5% KPP) ranged from $1.2\times10^5\pm$ 0.18to $5\times10^4\pm$0.17CFU/g,$1.1\times10^5\pm$ 0.17to $4.6\times10^5\pm$ 0.18CFU/g and $2.6\times10^6\pm$ 0.21to$4.4\times10^5\pm$ 0.19CFU/g, respectively. It is observed the highest amount of total bacterial count was found in control sample at 12-day and the lowest amountwas found in beef burger with 5%KPP at 0-day.

It can be seen that the increasingof storage time led to increase of total bacterial counts. Kiwi fruits peel powder had a strongeffect on the total bacterial counts in beef burger with KPP compared with

controlbeef burger. The increasing of kiwi fruits peel powder concentration resulted inreduction of total bacterial counts in beef burger during cold storage for 12 days compared to control.It is observed that inhibition the bacterial growth in beef burger mixed withkiwi fruits peel powder might attributed to its high content of phenolic compound and scavenging activity.

Oxidative rancidity and hydrolytic activity of microorganisms can be reducing in low level of pH**(Osterlie and Lerfall, 2005).El kichaoi*et al*. (2015)** concluded that some plant extracts such as *Actinidia deliciosa* containing inhibitor substances for the growth of microorganisms. **Shan *et al*. (2007)** reported that the partial hydrophobic nature of phenolic compounds may degrade the cell wall, interact with the composition and disrupt the cytoplasmic membrane, damage membrane proteins and interfere with membrane-integrated enzymes, which may eventually lead to cell death. **El Zawawy (2015)** reported that *Actinidia deliciosa*peels extract possessed antifungal activity against *A. flavus, A. niger, Candida albicans* and *P.digitatum.* Hexane extract of *Actinidia deliciosa* can inhibit the growth of Staphylococcus sp. **(Motohashi *et al.*, 2001).**

Table10: **Effect of kiwi fruits peel powder at different levels on total bacterialcountsin beef burgersat different time of storage for 12 days**

Samples	Total bacterial count (CFU/g)			
	Storage period (day)			
	0	4	8	12
Control beef burger	$2.9^{a}\times10^{5}\pm 0.20$	$3.1^{a}\times10^{5}\pm 0.18$	$8^{a}\times10^{4}\pm 0.23$	$8.5^{a}\times10^{4}\pm0.21$
Beef burgerwith 1%KPP	$1.2^{b}\times10^{5}\pm 0.18$	$1.5^{b}\times10^{5}\pm0.19$	$2.3^{b}\times10^{5}\pm0.20$	$5.0^{b}\times10^{4}\pm 0.17$
Beef burger with 3%KPP	$1.1^{b}\times10^{5}\pm 0.17$	$1.3^{b}\times10^{5}\pm 0.21$	$1.8^{c}\times10^{5}\pm 0.22$	$4.6^{c}\times10^{5}\pm 0.18$
Beef burger with 5%KPP	$2.6^{a}\times10^{6}\pm 0.21$	$2.8^{a}\times10^{6}\pm 0.18$	$1.5^{c}\times10^{5}\pm 0.21$	$4.4^{c}\times10^{5}\pm 0.19$
F(p)	**72.431*(<0.001*)**	**68.631*(<0.001*)**	**634.619*(<0.001*)**	**318.749*(<0.001*)**
LSD	**0.357**	**0.357**	**0.399**	**0.353**

F: **F for ANOVA test**, Pairwise comparison bet. each 2 groups was done using **Post Hoc Test (LSD)**

*: Statistically significant at $p \leq 0.05$

Means in the same **column** with **common letters** are not significant**.**

CFU/g= Colony Forming Unit/gram of sample

4. Conclusions

This work examined antioxidant and antibacterial properties of beef burger with kiwi fruits peel powder (KPP) throughout twelve days of cold storage. The chemical composition, antioxidant activity, total phenolic content, peroxide value and pH value were measured during different period of storage.Color stability was studied. Also, the effect of kiwi fruitspeelpowder on total bacterial count of uncooked beef burger was studied.Theobtained results confirmed that the use of natural antioxidant sources could be efficient in preventing lipid oxidation in meat products at cold storage.Therefore, kiwi fruitspeel hadstrong antioxidants to replace with the synthetic antioxidants, which are safe and suitable for food industries to extend the shelf-life of many processed foods.

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الأنشطة المضادة للأكسدةوالمضادة للبكتيريا لهامبورجراللحم البقري باستخدام مسحوق قشرثمارالكيوي

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الملخص العربى:

يهدف هذا العمل إلى دراسة الأنشطة المضادة للأكسدة والمضادة للبكتيريا في هامبورجراللحم البقري باستخدام مسحوق قشرثمارالكيوي (KPP) خلال فترات مختلفة من التخزين المبرد لمدة اثني عشريومًا ، تم اعداد هامبورجراللحم البقرى باستخدام ثلاث مستويات مختلفة 1 ٪ ، 3 ٪ و 5 ٪ من مسحوق قشرثمارالكيوي KPP، تم تقييم الصفات الحسية لهامبورجراللحم البقرى المطبوخ. المنتج الأكثر قبولا هو المنتج الذي تم تخزينه فى الثلاجة لمدة 12 يوم وتم اجراء الاختبارات عليه. تم قياس التغيرات في الرطوبة والرماد والدهون والبروتين والألياف الخام لهامبورجراللحم البقرى غيرالمطبوخ فى اوقات مختلفة من التخزين (4، 8، 12 يوم) ، أيضا تم قياس الأنشطة المضادة للأكسدة (DPPH) ، والمحتوى الكلي للفينولات ، وقيمة البيروكسيد وقيمة pHفى اوقات مختلفة من التخزين ، تم دراسة ثبات اللون،كذلكتم دراسة تأثيرمسحوق قشرثمارالكيوي بثلاث مستويات مختلفة (KPP) على العد الكلى البكتيري فى هامبورجراللحم البقري غير المطبوخ خلال فترات مختلفة من التخزين المبرد لمدة اثني عشريومًا ، أظهرت النتائج أن المعدل الأكثر قبولا لهامبورجراللحم البقري الممزوج بمسحوق قشرثمارالكيوي كان نسبة 5 % KPP . كانت قيم البروتين والرطوبة والرماد والدهون والألياف الخام والكربوهيدرات في مسحوق قشرثمارالكيوي6,86 ± 0,09 ، 3,45 ± 0,13 ، 7,76 ± 0,22 ، 0,86 ± 0,09 ، 8,05 ± 0,02 ، 73,02 ± 0,05٪ ، على التوالي . من الملاحظ أن إضافة مسحوق قشرثمارالكيوي بنسبة 5٪ إلى هامبورجر اللحمالبقري يعزز محتواه من البروتين والألياف بينما ينخفض محتواه من الرطوبة، وتقل معنوياً قيم البيروكسيد مقارنة بهامبورجر اللحمالبقر الكنترول في اليوم الثامن واليوم الثانيعشر.من خلال النتائج تم ملاحظة أن ارتفاع نشاط مضادات الأكسدة في مسحوق قشرثمارالكيوي يرجع إلى ارتفاع نسبة المركبات الفينولية. إضافة مسحوق قشرثمارالكيوي كمضاد أكسدة طبيعيعلى هامبورجراللحم البقري حسن من الثبات التأكسديوثبطنمو البكتيريا. أكدت هذه الدراسة أن مسحوق قشرثمارالكيوي يمكن أن يوفرمصادرمحتملة لمضادات الأكسدة الطبيعية ولهخصائصمضادة للبكتيريا ويمكن ان يستخدم بأمان في صناعة منتجات اللحوم.

الكلمات المفتاحية: قشرثمارالكيوي؛ الأنشطة المضادة للأكسدة؛ المحتوى الكلى للفينولات؛ التركيب الكيميائي؛ هامبورجراللحم البقرى؛ قيمة البيروكسيد؛ قيمة الحامضية؛الأنشطة المضادة للبكتيريا.