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Evaluation of Chicken Nuggets Formulated with Loquat (*Eribotrya japonica*) Seeds Powder

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ABSTRACT

The current research aimed to study the potential of using the loquat seeds powder as a component for nuggets production and its effect on quality characterizations of nuggets. Chicken nuggets produced using powder of loquat seed instead of wheat flour (w/w) by 0, 3.3, 6.6 and 10% levels substitution. The prepared chicken nuggets were evaluated for its chemical composition, cooking quality, Physico-chemical properties, microbiological evaluation and sensory attributes. Results illustrated that, substitution with LSP increased crude protein, ash and crude lipids content in the nuggets samples relative to control. Nuggets prepared with substituting wheat flour by different ratios of (LSP), at all the levels of incorporation, exhibited higher moisture and pH than control. In addition, total carbohydrates, cooking loss, and TBA of nuggets samples were decreased with increasing substitution levels of LSP. Utilization of loquat seed powder reduced the total bacterial count, yeast and mold of nugget samples compared with control sample. All samples had a high overall acceptability, particularly at 6.6 % level LSP. In conclusion, agro-industrial by-products such as LSP are good sources of phenolic compounds that have very potent antioxidant activity. Finally, it could be said that the addition of (LSP) appeared to be most effective as antimicrobial agent at the level of all used supplementing ratios in reduction of TBC in all treated samples. Moreover, its efficiency in controlling oxidative rancidity in chicken nuggets products enhancing the shelf- life without affecting on its sensory attributes.

Keywords: Agro-industrial by-products, Chicken products, Physicochemical properties, Cooking quality, Microbiological evaluation and Sensory attributes.

INTRODUCTION

Nowadays, various health-related aspects of food, such as its functionality, the presence of additives and their origins play an increasingly important role for consumers, and consequently for food producers and distributors. The number of studies focusing on the mode of action and applications of novel sources of natural products as functional food ingredients has therefore increased immensely during recent years. Natural antioxidants, as valuable food components both in vitro and in vivo, have been the most frequent focus of these studies (Povilaityte and Venskutonis, 2000 and Pukalskas *et al.,* 2002). The peels and seeds which are usually disposed of as waste material in many food processing industries could be used as a rich source of beneficial phytochemicals. Furthermore, this could prevent environmental pollution and economic losses. The principal objective of the economic exploration of loquat is the production of its fruits, which can be eaten fresh or processed into jam and jelly, although its leaves have been used for treatment of skin diseases and diabetes, chronic bronchitis, coughs, phlegm, ulcers and cancer (Ito *et al.,* 2000).

Loquat seed is the waste of loquat fruit (*Eribotrya japonica*). Loquat or Japanese plum (*Eriobotrya japonica*) belongs to the Rosaceae family. It originated in south-eastern China and later became naturalized in Japan, India and many other areas. Loquat seed is called ‘‘good for health” in Japan (Koba *et al.,* 2007). Loquat seed contains some active compounds, such as vegetable sterols (β-sitosterol) (Yokota *et al.,* 2006). Loquat seeds have the highest polyphenols content and show the most potent activity against lipid oxidation (Koba *et al.,* 2007). Loquat seeds contain such active constituents as flavonoids, tannins and amygdalin (Hamada *et al.,* 2004 and Tanaka *et al.,* 2008). The antioxidant supplementation is a generally accepted method of prolonging the stability and storage life of food products, in particular the ones including fat (Jayaprakasha *et al.,* 2003). Chicken nuggets is a ready to cook and ready to eat product with simple preparation makes it a popular choice with consumers for a quick meal. The quality of nuggets can be significantly affected by processing, raw material and ingredient factors, either from nutritional value or overall acceptability by consumers (Lukman *et al.,* 2009). Thus, the objective of this study was to investigate the antioxidant and antimicrobial potential of loquat seed powder and its efficiency in controlling oxidative rancidity in chicken nuggets products and its effect on quality characterizations.

MATERIALS AND METHODS

Materials

Loquat fruit

Loquat (*Eriobotrya japonica*) fruit at commercial maturity stage was obtained from El Basatine Research Institute, El-Qanatir Alkhayriyah city, Qalyubiyah Governorate, Egypt.

Fresh chicken breast meat

Chicken breast meat (without bones and skin) which used in manufacture of nuggets, were purchased from a local market in Tanta City, Gharbiya Governorate, Egypt.

Methods

Preparation of loquat seeds powder

Fresh loquat fruits were washed by fresh tap water. The seeds were manually removed from edible parts. Seeds were cleaned with distilled water to remove the undesirable materials. Then, external moisture was wiped out with a dry cloth (Tasken *et al*., 2011). Loquat seeds were dried at 50°C. The dried seeds were ground in a laboratory mill (Moulinex, model No 205, made in France) to pass through 20 mesh screen to obtain seeds powder. Powder of seeds was stored in polyethylene bags until subsequent analysis.

Preparation of chicken nuggets

Chicken nuggets were prepared according to the method of (Bintoro, 2008). The formulas are presented in Table (1). Chicken breast meat was cleaned and ground by meat grinder (Moulinex, model No 205, made in France). Mixed the minced breast meat with wheat flour, skim milk powder, salt, dried onion, dried garlic and pepper powder. The mixture was served as (control sample). Then, replay the same method with adding loquat seeds powder at different levels (3.3, 6.6 and 10%) as replacement of wheat flour and then mixed to create homogenate meat mixture. The final mixture put in freezer for 5 min. Chicken nuggets were shaping and cooling for 15 min at 5ºC. Samples were stored in polyethylene bags until analysis.

Table 1. Ingredients of chicken nuggets formulas as (g/100g)

Ingredients (g)	Control	Treatments (T)		
		T_1	T_2	T_3
Chicken breast meat	80	80	80	80
Wheat flour	8	5.30	2.6	-
loquat seed powder (LSP)	-	2.7	5.4	8
Skim milk powder	8	8	8	8
Dried garlic	1.4	1.4	1.4	1.4
Dried onion	0.8	0.8	0.8	0.8
Sodium chloride	1	1	1	1
Pepper powder	0.8	0.8	0.8	0.8
Total	100	100	100	100

Cooking of chicken nuggets

The chicken nuggets were deep fried in vegetable oil at 180°C for approximately 4 min until an internal temperature of 72°C was reached. Thermometer (HANNA) was used to internal temperature of the samples (Polizar *et al*., 2015).

Analytical methods:

Proximate chemical composition: Moisture, crude protein, crude lipid, crude fiber and total ash were determined according to (A.O.A.C., 2005). T. carbohydrates content were calculated by difference (100- fat + protein + ash + crude fiber) as reposted by (Tadrus, 1989).

Determination of thiobarbituric acid number:

Thiobarbituric acid value was determined according to procedure described by Pearson *et al*. (1991). TBA values were calculated by TBA value (mg malonaldehyde / Kg sample) = OD × 7.8

Physical properties:

Determination of pH value: 2 grams of sample were homogenized in 10ml distilled water. The pH was measured by using pH meter (Jenyway model No 3510, made in UK) as described in (A.O.A.C., 2005).

Determination of cooking loss: Cooking loss of nuggets samples was estimated according to method described by Polizer *et al.* (2015). Three samples of each formulation were weighed before and after the frying process as previously described. The percentage of weight loss was calculated according to the equation:

% cooking loss = (Initial Mass – Final Mass) ×100/Initial mass

Determination of water activity: The water activity was measured directly with an Aqua Lab water activity meter (Decagon Devices, models CX2 , Pullman,) according to the method described by Biceroglu (2012).

Determination of nuggets color: Nuggets samples were measured according to the method described by Amin *et al*. (2014) for color using a Minolta colorimeter (Konica Minolta, model No CR- 300, made in Germany). The color parameters were defined as L*, a*, b* system. In this coordinate system L* value is a measure of lightness ranging from black to white, a* value ranges from – (greenness) to + (redness) and b* ranges from – (blueness) to + (yellowness)

Microbiological aspects:

Preparation of samples: Samples were prepared using the recommended methods for the microbiological examination of food published by (A.P.H.A., 1976).

Total plate count: The total bacterial count of samples was determined using nutrient agar medium as described by FAO. (1992). The plates were then incubated at 37°c for 48-72 hrs. The number of colonies was multiplied by the reciprocal of the respective dilution and expressed as log cfu/g.

Psychrophilic bacterial count: Psychrophilic bacterial count of samples was determined according to Difco Manual (1984) using nutrient agar medium. The plats were incubated at 8°C for 5 days.

***Staphylococcus aureus* count:** The method described by Oxoid (1992) was followed for the determination of *Staphylococcus aureurs* of samples using Baird parker medium. The medium was sterilized by autoclaving then, cooled to 50°C and 50 ml of egg yolk emulsion SR54 were added. Mixed well before pouring. The plates incubated at 37°C for 24 hrs.

Detection of coliform bacteria: The coliform bacteria were determined using MacConkey broth medium according to the procedures described by A.P.H.A. (1976) and Difco Manual (1984). The tubes were incubated at 37ºC for 24 hrs.

Detection of *Salmonella spp*.: S.S Agar (Salmonella Shigella Agar) medium as described by Bryan (1991), was used for the detection of Salmonella group. Suspend 63g of S.S Agar in the distilled water. Boil with frequent agitation to dissolve the medium completely don't autoclaving. Cool it about 50°C. Mix and pour in sterile petri plates containing previously prepared serial dilution then incubate at 37°C for 48hrs.

Mould and yeast count: The mould and yeast count was determined of samples using the methods described by FAO (1992) using potato dextrose agar medium, incubation at 20-25°C for 5 days.

Sensory evaluation of nuggets samples: Sensory evaluation of nuggets samples was carried out by staff from Special Food Department of Food Science and Technology Research Institute. They were asked to evaluate appearance, colour, tenderness, flavor, juiciness and overall acceptability. A numerical hedonic scale which ranged from 1 to 10 (1 is very bad and 10 for excellent) was used for sensory evaluation as described by Yetim and Kesmen, 2009).

Statistical analysis: The statistical analysis was carried out using SPSS. Statistical software (version 11.0 SPSS inc., Chicago, USA), the results were expressed as mean. Data were subjected to analysis of variance (ANOVA). The differences between means were subjected to analysis of variance and least significant difference (LSD) test as reported by Snedecor and Cochran, (1980).

RESULTS AND DISCUSSION

Proximate composition of chicken nuggets samples

Table (2) shows the effect of various loquat seed powder (LSP) supplementation ratios on contents of moisture, Crude lipid, crude protein, ash and total carbohydrate of fresh chicken nuggets (on wet weight basis) at zero time. Obtained data illustrated that, the moisture content of the control chicken nuggets and samples containing (LSP) at levels of 3.3, 6.6, 10.0% increased by increasing (LSP) as substituting ingredients from 3.3 up to 10%. It is well known that the moisture content is important for preservation because low moisture content lowers water activity and helps inhibit microbial growth. The lowest moisture content was 61.25% in control nuggets while in supplemented samples, it showed a considerable increase at the levels of (3.3, 6.6 and 10%) giving the values of (62.12, 62.85 and 63.37%) respectively. The effects of substituting wheat flour with different ratios of (LSP) at zero time on crude lipid content of chicken nuggets are shown also in Table (2). From the obtained results, it could be noted that, crude lipids content of control nuggets which was 9.51% increased significantly to reach 10.35% for chicken nuggets contained 10%LSP. Crude protein content of control nuggets registered 21.05 % that revealed slight increase recording the numbers (21.35, 21.56 and 21.79%) for chicken nuggets which contained 3.3, 6.6 and 10% LSP, respectively. From the above-mentioned results, it could also have observed that the control nuggets contained the lowest ash value (2.25%) which increased to 2.39, 2.41 and 2.53% by increasing LSP substitute ratio of 3.3, 6.6 and 10%, respectively. On the other hand, total carbohydrate content of all samples was significantly lower comparing with the control nuggets samples which had the highest total carbohydrate content recording (5.94%); while the substituted samples recorded 4.12, 2.92 and 1.96% at the approximate levels of 3.3, 6.6 and 10%, respectively showing higher significant decrease. Our results agreed with Kumar and Tanwar, (2011) who showed that, the approximate composition of chicken nuggets control (moisture, protein, lipids and ash) was (62.0, 15.3, 12.9 and 2.76%) respectively. Meanwhile, Polizer *et al.,* (2015) reported that, the approximate composition of chicken nuggets control (moisture, ash, lipids, protein and carbohydrates) registered the values of (47.40, 2.07, 14.32, 17.41 and 19.16%) respectively. Also, Verma *et al.,* (2013) found that, the approximate composition of chicken nuggets control (moisture, protein, lipids and ash) gave the values of (67.01, 12.53, 10.26 and 2.55%) respectively.

Statistical analysis showed significant increase of (moisture, protein, fat and ash) with increasing the supplementing LSP ratios when compared to the control, but nonsignificant between treatments. On contrast, significant decrease was observed for the T.carbohydrates parameter with increasing LSP ratios at the level of all substituted samples.

Table 2. Proximate composition (%on wet weight) of chicken nuggets formulated with different ratios of (LSP) at zero time.

Samples	Moisture	Crude lipids	Crude protein	Ash	T. Carbohydrates
Control	61.25^{b}	9.51^{c}	21.05^{c}	2.25^{b}	5.94^{a}
3.3% LSP	62.12^{ab}	10.02^{b}	21.35^{b}	2.39^{ab}	4.12^{b}
6.6% LSP	62.85^{a}	10.26^{a}	21.56^{a}	2.41^{a}	2.92^{c}
10.0% LSP	63.37^{a}	10.35^{a}	21.79^{a}	2.53^{a}	1.96^{d}
LSD at 5%	2.096	0.284	0.253	0.142	0.165

In a column, means having the same superscript small letters are not significantly different at 5% level for chicken nuggets.
LSD = Least significant differences. A carbohydrate was estimated by difference.

Physico-chemical properties of chicken nuggets samples:

Data presented in Table (3) illustrate the physico-chemical properties of chicken nuggets supplemented with different ratios of loquat seeds powder (LSP) at zero time. From the obtained results, it could be noticed that, pH value of chicken nuggets control registered 6.28 which was significantly increased to (6.35, 6.38 and 6.38) with the chicken nuggets samples contained (3.3, 6.6 and 10%LSP) respectively. Kumar *and Tanwar* (2011) showed that, pH value of control chicken nuggets was 6.1. Meanwhile, Polizer *et al.,* (2015) reported that, the pH value of control chicken nuggets was 5.48.

The results of hunter color scale parameters, Lightness (L*), redness (a*) and yellowness (b*) of chicken nuggets supplemented with different ratios of (LSP) are showed that; all color parameters changed significantly. Since, Lightness (L*) and yellowness (b*) of chicken nuggets samples were significantly decreased with increasing the substituting ratio of LSP at the level of all samples. The Lightness (L*) and yellowness (b*) of control chicken nuggets recorded (63.27 and 23.78) with slightly decrease ranged from (61.21 to 21.36) in chicken nuggets samples contained 10% LSP. Redness value (a*) for control chicken nuggets gave the value (2.64) which was significantly increased among the samples recording the values (2.85, 2.96 and 3.14) for the chicken nuggets treatments at zero time respectively. It was also noted that the lowest redness (a*) value was for control nuggets (2.64) while the highest one was for the ratio (10% LSP). Yogesh and Ali, (2014) found that, the color value of (L*, a* and b*) of control chicken nuggets reached to (58.8, 6.3 and 15.1) respectively. Polizer *et al.,* (2015) showed that, the color value of control chicken nuggets (L*, a* and b*) scored (69.90, -1.09 and 9.25) respectively. From the same Table(3), it could also be noticed that the cooking loss of

chicken nuggets supplemented with different levels of (LSP) had been decreased significantly at zero time by increasing substituting ratios as following (18.56, 17.37 and 16.55%) compared with the control sample which gave 20.19 %.

From the statistical analysis of data in Table (3) insignificant increase in water activity values could be noticed among all chicken nuggets samples supplemented with different levels of (LSP). Water activity values of the control and the treated samples ranged from 0.968 to 0.981 showing an agreement with the work of (Kumar *and Tanwar,* 2011) who reported that, this parameter was 0.972 for the control sample. Thiobarbituric acid reactive substances is one of the most widely used methods for measuring oxidative rancidity in food. The effect of addition of LSP on the oxidative stability of chicken nuggets is shown in the TBA values of chicken nuggets supplemented with different levels of (LSP) that were illustrated by the same Table (3). It could be observed that, TBA values in raw chicken nuggets samples ranged from 0.28 to 0.18 with slight significant differences among all fresh samples. These data agreed with Lau and King, (2003), who reported that poultry meat patties containing grape seed extract had low levels TBARS than counter parts. In our results the lowness in TBA values in supplemented samples of our product (chicken nuggets) which could be attributed to the anti-oxidant properties of LSP that contain high levels of bioactive phenolics, flavonoids that can help to control lipid oxidation because this compound can inhibit free radical formation.

Table 3. Physico-chemical properties of chicken nuggets formulated with different ratios of (LSP) at zero time

Samples	pH	Color			Cooking loss (%)	^{a}w	TBA (MDA/kg)
		L^*	a^*	b^*			
Control	6.28^{b}	63.27^{a}	2.64^{d}	23.78^{a}	20.19^{a}	0.968^{a}	0.28^{a}
3.3% LSP	6.35^{ab}	62.55^{a}	2.85^{c}	22.65^{b}	18.56^{b}	0.973^{a}	0.25^{a}
6.6% LSP	6.38^{a}	61.98^{b}	2.96^{b}	22.07^{bc}	17.37^{c}	0.978^{a}	0.20^{b}
10.0% LSP	6.38^{a}	61.21^{b}	3.14^{a}	21.36^{c}	16.55^{c}	0.981^{a}	0.18^{b}
LSD at 5%	0.031	1.09	0.12	0.51	0.83	0.028	0.042

In a column, means having the same superscript small letters are not significantly different at 5% level for chicken nuggets
LSD = Least significant differences. L^* (lightness), a^* (redness), b^* (yellowness) ^{a}w means water activity. TBA means Thiobarbituric acid.

Microbiological characteristics of chicken nuggets samples

Phytochemicals, derived from various plant sources have been shown to be a good alternative to synthetic chemical substances in preventing growth of several pathogenic bacteria. Effect of different levels of loquat seeds powder (LSP) on total bacterial count (TBC), yeast and mold of supplemented chicken nuggets is shown in Fig.1. From the data shown in this figure, it could be observed that, total bacterial count in chicken nuggets ranged from 2.47cfu/g for the control sample to 2.17cfu/g for the sample with 10.0% (LSP) replacement showing considerable decrease between the control and all chicken nuggets samples. The lowest TBC (2.17 cfu/g) was recorded for the sample 10.0% (LSP) replacement followed by the sample 6.6% (LSP) (2.23 cfu/g) and the sample with 3.3% (2.44cfu/g). In conclusion, it could be said that, (LSP) appeared to be most effective as antimicrobial agent at the level of all used supplementing ratios in reduction of TBC in all treated samples. Kumar and Tanwar, (2011) found that, the total plate count of control chicken nuggets was 2.5cfu/g at zero time. From the presented data, it could be noticed that, there were a clear decrease in yeast and mold values among all fresh samples. The highest value was recorded for the control sample was (0.95cfu/g) followed by (0.63cfu/g) for 3.3%LSP, (0.48cfu/g) for 6.6 %LSP and the lowest value was (0.30cfu/g) for sample with 10.0 % (LSP). Pathogens (salmonella, *E. coli* and staphylococci) not detected whether in control or treated samples at all levels of all supplementing ratios of (LSP). Several studies have demonstrated the antimicrobial activity of phenolic compounds from plant extracts (Fernandez-Lopez *et al.,* 2005). It has been observed that the plant-based phenolic compounds can cause disruption of the cytoplasmic membrane, depletion of proton motive force and finally coagulation of cell contents (Lambert *et al.* 2001; Shan *et al.*, 2007 and Tiwari *et al.*, 2009).

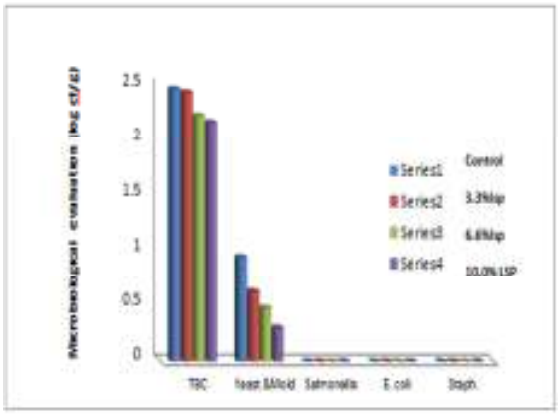

Fig. 1. Microbiological evaluation of chicken nuggets formulated with different ratios of (LSP) at zero time

Sensory evaluation of chicken nuggets samples

Table (4) and Fig (2) demonstrates the effect of different levels of loquat seed powder (LSP) on appearance, colour, flavor, tenderness, Juiciness and overall acceptability of the fried chicken nuggets at zero time. From these data, it could be noticed that, sample of 3.3 % had the highest appearance scoring (9.08) degree followed by (9.02) for the sample 6.6% and (8.17) degree for 10.0% while the control sample achieved the score of (9.04) degree showing slight significant differences. Furthermore, there were low significant differences in juiciness scores between all samples. The control sample had the highest juiciness

scored (8.83) degree followed by 3.3%LSP then 6.6 (LSP) scoring (8.82) and (8.76) degrees, respectively with insignificant differences. On the other hand, the lowest Juiciness value was obtained by the sample 10.0% which scored the average value of (7.26) followed by 6.6% (LSP) which was (8.76) with significant differences. Data of the same table showed insignificant differences between the two other treatments (3.3 and 6.6%) compared the control sample for tenderness scores. The lowest score for these parameters could be observed at the level of treatment 10.0 % (LSP) recording the average value 7.31 degree. Contrarily, the overall acceptability of the treatment with 6.6% replacement showed the highest score value (9.05) followed by the treatment 3.3% replacement (8.99) and the control sample (8.97) respectively. Judge *et al.,* (1989) found that, tenderness is affected by the meat ingredient and spices added in the manufacture of meat product. In conclusion, agro-industrial by-products such as LSP are good sources of phenolic compounds that have very potent antioxidant and antimicrobial activity. Thus, on basis of microbiological, sensory and oxidative studies was obtained can used LSP treated chicken products. This study indicates that unutilized loquat seed powder can be used commercially in the food industry as potential natural preservative. A moderate intake of such antioxidant rich loquat seeds may be beneficial to human health.

Fig. 2. Fried chicken nuggets formulated with different ratios of (LSP)
C= Control, I= Chicken nuggets formulated with 3.3% LSP, 2= Chicken nuggets formulated with 6.6% LSP and 3= Chicken nuggets formulated with 10% LSP

Table 4. Sensory evaluation of fried chicken nuggets formulated with different ratios of (LSP) at zero time

Samples	Appearance (10)	Color (10)	Flavor (10)	Tenderness (10)	Juiciness (10)	Overall acceptability (10)
Control	9.04[a]	8.68[a]	8.82[a]	8.93[a]	8.83[a]	8.97[a]
3.3% LSP	9.08[a]	8.84[a]	8.90[a]	8.86[a]	8.82[a]	8.99[a]
6.6% LSP	9.02[a]	8.75[a]	8.81[a]	8.82[a]	8.76[a]	9.05[a]
10.0% LSP	8.17[b]	7.23[b]	6.62[b]	7.31[b]	7.26[b]	6.54[b]
LSD at 5%	0.21	0.38	0.29	0.37	0.32	0.39

In a column, means having the same superscript small letters are not significantly different at 5% level for chicken nuggets
LSD = Least significant differences.

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تقييم ناجتس الدجاج المعد بمطحون بذور البشملة

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استهدف البحث الحالى دراسة امكانية استخدام مطحون بذورالبشملة كأحد مكونات خلطة ناجتس الدجاج ودراسة تأثيراضافته على خواص جودة المنتج. حيث تم تجهيز خلطة ناجتس الدجاج باستخدام مطحون بذور البشملة بمستويات استبدال (صفر-٣،٣-٦،٦-١٠%) من دقيق القمح. تم تقييم ناجتس الدجاج المجهز بالنسبة للتركيب الكيماوى، جودة الطهى، الخواص الفيزوكيماوية، الجودة الميكروبيولوجية ، التقييم الحسى.أوضحت النتائج المتحصل عليها أنه ترتب على التدعيم بمطحون بذور البشملة زيادة محتوى عينات الناجتس من البروتين الخام والرماد والدهن مقارنة بالعينة القياسية .كما أظهرت جميع مستويات الاستبدال مقارنة بالعينة القياسية، زيادة محتوى الرطوبة ودرجة تركيز ايون الهيدروجين ، وانخفاض كل من الكربوهيدرات الكلية والفقد أثناء التحمير، محتوى حامض الثيوباربيوتريك لعينات الناجتس بزيادة نسبة الاستبدال. هذا علاوة على أن استخدام مطحون البذور أدى الى خفض العد الكلى للبكتيريا وكذلك أعداد الفطريات والخمائرفى عينات الناجتس مقارنة بالعينة القياسية. سجلت جميع العينات درجات عالية للتقييم الحسى الكلى خاصة المعاملة ٦،٦% استبدال.وعليه نرى أن مطحون بذور البشملة تعتبر مصدرا جيدا للمركبات الفينولية ذات الأهمية الكبرى كمصدر للنشاط المضاد للأكسدة على المستوى الصناعى. وفى النهاية يمكن القول أن اضافة مطحون بذور البشملة يعتبر ذات تأثير هام كمصدر للمضادات الميكروبية على جميع مستويات الاستبدال المستخدمة فى جميع المعاملات هذا علاوة على الكفاءة العالية فى التحكم فى النشاط التأكسدى فى منتجات ناجتس الدجاج مما يترتب عليه اطالة فترة الحفظ في حالة التخزين لفترات أطول من المعدل دون التأثير على الخواص الحسية للمنتج.