

UTILIZATION OF DATE PALM POLLEN AS NATURAL SOURCE FOR PRODUCING FUNCTION BAKERY PRODUCT

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Abstract

In the present study, date palm pollen was studied as potential healthy ingredient for preparing the nutritional function butter cake. Polyphenols content from date palm pollen extract were fractionated using HPLC and the results reported that the date palm pollen had contained the highest content polyphenols compounds. Rutin, apigenin and coumarin were the highest amounts content (15.43, 12.26 and 11.12%) followed by chlorogenic, O – coumaric, gallic acid, quercetin and luteolin. Date palm pollen and its extract were added separately to wheat flour 72% at levels 3.0, 6.0 and 9.0% date palm pollen and their extract at 100, 200 and 300 ppm levels to give six blends, respectively. Date palm pollen (DPP) and wheat flour 72% extract and its blends were analyzed for their chemical constituents and minerals content. The results indicated that the DPP had contained the highest crude protein, lipid, ash and fiber (32.95, 19.31, 4.17 and 8.51%, respectively) and when the DPP increased amount in the blends the chemical constituents increasing. The obtained results from the minerals composition of date palm pollen and wheat flour 72% extract and their blends revealed that the date palm pollen constitute of mineral. Sensory properties showed that the butter cake made from wheat flour 72% extract as a control had the highest degree (98.78%) and the blends prepared by adding the natural antioxidant from date palm pollen at 100, 200 and 300 ppm were higher of sensory acceptance than butter cake made from 3, 6 and 9% date palm pollen. Peroxide value was determined in shortening which extracted from butter cake made from date palm pollen and their extract. Biological activity as total bacteria and fungi count were estimated in butter cake during storage period for four weeks. The results showed that the total count of bacteria for butter cake from DPP was ranged from 33.6 to 42.8 × 10⁶ CFU and their extract of DPP had contained 32.2 to 40.4 × 10⁶ CFU after four weeks and the total count of fungi was parallel to the bacteria count. It may be recommended that the date palm pollen rich in protein, lipid, and minerals content and natural antioxidant. Therefore, the addition of date palm pollen and their extract for butter cake effectively inhibited to increase in peroxide value and biological activity for four weeks period for producing function bakery product.

INTRODUCTION

Phoenix dactylifera L (Date Palm) belong to family Arecaceae, called Nakhla and the Tree of Life by the Arabs. It is member of the monocotyledon family Arecaceae (Phillipson, 2001).

The early Egyptians and ancient Chinese used date palm pollen as a rejuvenating medicinal agent. It has been called a fountain of youth. Pollen preparations are distributed worldwide for dietary purposes and as diet supplement by increasing the total dietary intake (Kroyer and Hegedus, 2001).

Date palm pollen application in the rites, and its uses in traditional and herbal medicine, has been recorded throughout history. Variety of pollen containing food products, such as candy and chocolate bars, are commercially available in health food stores in the Western world (Stanley and Linkens, 1974). They contain concentration of photochemical and nutrients and are rich in carotenoids flavonoids and phytosterols (Broadhurts, 1999). Moreover, they are good source of protein, amino acid, vitamins, dietary fiber, fatty acid, enzymes, hormones and minerals (Alferez and Campos, 2000).

Suspension of *Phoenix dactylifera* date palm pollen (DPP) is an herbal mixture that is widely used as a folk remedy for curing male infertility in traditional medicine Bahmanpour *et al.* (2006). A thousand tones of DPP are produced every year by millions of palm trees grown in the Arabian region. DPP differed from bee pollen in that it is of a known source and its homogeneity, purity and is easily to be standardized. DPP was reported to have gonadal stimulating potency as well as fertility promotion in women in ancient Egypt Bajpayee (1997). It was reported that date pollen grain extracts contain estrogenic materials, estrone, as gonad-stimulating compounds that improve male infertility and exhibit gonadotrophin activity in the rat Dostal and Faber (1996). Cernilton is another pollen extract derived from several different plants in southern Sweden and has been known to be effective in the treatment of chronic a bacterial prostatitis and prostatodynia Ebeling (1986) and Buck and Rees (1989).

In addition to this, pollen also has high contents of polyphenolic substances, chiefly flavonoids with antioxidant (Kroyer and Hegedus, 2001) and antimicrobial activity (Basim *et al.*, 2006). During the last decade, interest in the study of phenolic compounds has increased greatly, mainly due to the antioxidant capacity of these substances in scavenging free radicals that are harmful to human health (Dorman *et al.*, 2003). Epidemiologic studies have also demonstrated positive correlation between the increase in phenolic compound consumption with antioxidant action (Javanmardi *et al.*, 2003) and reduction of the risk of cardiovascular diseases and certain types of cancer (Cook and Samiman, 1996).

The biological properties of phenolic compounds are related to the activity that each phenol exercises in a certain medium, and the chemical structure of flavonoids favors antioxidant action. The high capacity of the phenolic constituents to

neutralize the species reactive to oxygen are strongly associated with their structure, such as conjugated double bonds and number of hydroxyls in the aromatic ring of flavonoids and cinnamic acid derivatives (Campos *et al.*, 1997). The radical DPPH is widely used to test the free radical scavenger capacity in apicultural products such as, pollen (Silva *et al.*, 2006; Leja *et al.*, 2007), propolis (Lu *et al.*, 2003; Kumazawa *et al.*, 2004) and honey (Meda *et al.*, 2005). The antioxidant activity using the stable free radical DPPH is based on the transfer of electrons from an antioxidant compound to a free radical, DPPH which, when it is reduced, loses its purple coloring. Thus, only the reducing power of the antioxidant is assessed, which becomes oxidized when it donates an electron, and for this reason does not detect pro-oxidant substances (Brand-Williams *et al.*, 1995).

The beneficial health and nutrition values of *Phoenix dactylifera* L. for human and animal consumption have been claimed for centuries (Barreveld, 1993). Experimentally, date extracts have shown to increase sperm count in guinea pigs; and to enhance spermatogenesis and increase the concentration of testosterone, follicle stimulating hormone (FSH), and luteinizing hormone (LH) in rats (El-Mougy *et al.*, 1991). The property of Date Palm pollen to increase serum testosterone level was evaluated in a parallel study (Iftikhar *et al.*, 2011).

The aim of this investigation is to utilize from date palm pollen as a powder and extract. Date palm pollen (DPP) is rich in antioxidant and these antioxidants were extracted and added to butter cake at levels 100, 200 and 300 ppm and its compared with butter cake made from DPP at levels 3, 6 and 9% , respectively. Sensory properties and biological activity were determined.

MATERIALS AND METHODS

Materials:

The pollen grains of Egyptian date palm (*Phoenix dactylifera* L.) variety El-Hayani was purchased from the Central Laboratory of Date Palm Research and Development, Agricultural Research Center, Giza- Egypt. The date palm pollen (DPP) grains were cleaned from the dust using air-dry and it's kept in a refrigerator at 5 °C till used.

Wheat flour 72% extraction (*Triticum aestivum* L.) was obtained from the North Flour Mills Company, Egypt.

Shortening (Rawaby consider refined palm oil, 100% pure vegetables oil and its cholesterol free) was obtained from Safola Egypt Company 10th Ramadan City, Cairo. Skim milk, vanilla, sugar and baking power were purchased from local market.

Methods:**Fraction of polyphenols by HPLC for date palm pollen extract:**

Dried date palm pollen (100g) was finely powered and extracted with petroleum ether (40- 60 °C) to remove fats and any resinous materials. The residue was exhaustively extracting with one liter ethanol 70% by heating on a boiling water bath for six hours. Extraction was repeated until a color extract then the extracts were combined and concentrated to obtain aqueous ethanol extract and kept in a refrigerator at 6 °C till HPLC Technique analysis. High Performed Liquid Chromatography (HPLC) Model Hewlett Packard series 1100 (HP 1100) and Column which used hypersil BDS 5.0 µm C 18. Detector UV 254 nm. Flow rate 0.3 mL/ min. Mobile phase A: (0.5 mL acetic acid/99.5 mL distilled water). B (0.5 mL acetic acid /99.5 mL acetonitrile). Temperature ambient at 25 °C according to Merfort *et al.* (1997).

Preparation and extraction of butter cake:

The ingredients of raw materials (wheat flour 72% extraction, date palm pollen and extract of date palm pollen) were used in the preparation of butter cake according to Mizukoshi *et al.* (1979). Wheat flour 72% extraction (100gm.) mixed with 50gm shortening; 100gm. sugar, 3.0gm baking powder, 75.0 g. egg, 3.0gm vanilla and 7.0 gm skim milk were added to give control. Date palm pollen and its extract were added separately to control at levels 3.0, 6.0 and 9.0% date palm pollen and their extract at 100, 200 and 300 ppm levels to give six blends, respectively.

Chemical constituents of raw materials and its blends:

Protein, total fat, ash and crude fiber were determined in raw materials (wheat flour 72% extraction and date palm pollen) and their blends according to the method outlined in AOAC (2005). Minerals content copper (Cu), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn) and manganese (Mn) were determined in the diluted solution of ash raw materials using the atomic absorption spectrophotometer (3300 Perkin-Elme) as described in by AOAC (2005) method.

Organoleptically evaluation for different blends of butter cake:

The butter cake blends were baked at 190° C for 25 minutes in an electric oven. Butter cake was allowed to cool on racks for about one hour before evaluation. The organoleptically evaluation for different blends of butter cake was estimated by ten experienced panelists according to AACC (2002). Also, shortening were extracted from butter cakes every week for four weeks by soaking n-hexan at room temperature for 48 hr. The extract was filtrated and evaporated from the solvent. Shortening was kept in deep freezer for further investigation.

Peroxide value as physico-chemical characteristics was determined in shortening which extracts from butter cake made from date palm pollen and their extract as millequivalent / kg oil according to AOAC (2005).

Determination of microbiological analysis:

Biological activity as total count of bacteria and fungi were estimated by the plate methods of Martin (1950) and Allen (1959) in butter cake which made from date palm pollen and its extract during storage at room temperature for four weeks. Plates of biological activity were incubated in incubator at 30 °C for three days.

Statistical analysis:

The data obtained were analyzed by using SPSS statistical software (version 13 SPSS Inc., Chicago. USA). The results were expressed as mean \pm SD, and tested for significance using one-way analysis of variance "ANOVA" according to Armitage and Berry, (1987).

RESULTS AND DISCUSSION

Polyphenols content in ethanol extract from date palm pollen.

Polyphenols content from date palm pollen extract were fractionated using HPLC and the results are reported in Table (1). From the results it could be noticed that the date palm pollen had contained the highest content polyphenols. Rutin, apigenin and coumarin were the highest amounts content (15.43, 12.26 and 11.12%) followed by chlorogenic, O – cumaaric, gallic acid, quercetin and luteolin were amounted 9.33, 9.05, 8.54, 8.15 and 8.04%, respectively. Whereas, kaempferol and ferulic are presented in date palm pollen and also, the smallest amounts in date palm pollen were myricetin, P – cumaaric and naringin polyphenols.

Flavonoids present in plants possess diverse health benefits, which includes antioxidant and radical scavenging activities, reduction of certain chronic diseases, prevention of some cardiovascular disorders and certain kinds of cancerous processes (Tapas *et al.*, 2008). Hong *et al.* (2006) assessed the flavonoid content in the Deglet Noor variety during the Khalal stage of maturity and identified 13 flavonoid glycosides of luteolin, quercetin and apigenin. Quercetin and luteolin formed primarily Oglycosidic linkages whereas apigenin was present as the C-glycoside. As of today, dates also have the unique distinction of being the only food to contain flavonoids sulfates (Hong *et al.*, 2006). Chaira *et al.* (2009) recently reported that among the famous Tunisian dates, the highest content of flavonoids was present in the Korkobbi variety (54.46 quercetin equivalents/100 g fresh weight).

Table 1. Percent of polyphenols content in ethanol extract from date palm pollen.

Compounds	Retention time	Date palm pollen
Kaempferol	36.286	6.54
Quercetin	32.213	8.15
Naringin	31.406	1.28
Apigenin	29.368	12.26
Myricetin	28.030	2.92
Coumarin	25.718	11.12
O - Cumaaric	25.243	9.05
Rutin	24.006	15.43
Luteolin	22.972	8.04
Ferulic	22.465	5.00
P - Cumaaric	21.025	2.34
Chlorogenic	16.380	9.33
Gallic acid	7.310	8.54

Chemical compositions of raw materials and their blends:

Date palm pollen (DPP) and wheat flour 72% extract and its blends were analyzed for their constituents of crude protein, lipid, fiber, ash and total carbohydrates. The obtained data are given in Table (2) indicated that the DPP had contained the highest crude protein, lipid, ash and fiber (32.95, 19.31, 4.17 and 8.51%, respectively). The blends made from wheat flour 72% extract fortified with 3, 6 and 9% date palm pollen, the results illustrated that when the DPP increased amount in the blends the chemical constituents increasing. Total carbohydrates were the highest amounted in wheat flour 72% extract (82.79%). Whilst, the blends were decreased in total carbohydrates by increasing DPP due to the date palm pollen had contained the lowest total carbohydrates (35.06%).

Dates fruits have high composition of carbohydrates, salts and minerals, dietary fiber, vitamins, fatty acids and amino acid gives a unique value in human nutrition Al-Shahib and Marshall (2003). Date palms play a significant role in neutralization of free radical and finally suppress the various types of diseases development and progression. Earlier investigation found that palm date has a potent ability to suppress free radicals Al-Farsi *et al.* (2005).

Table 2. Chemical compositions of raw materials and their blends (on dry weight basis).

Chemical analysis	Date palm pollen	Control	Blends		
			3 %	6 %	9 %
Protein	32.95	12.69	13.10	14.69	15.30
Lipid	19.31	2.13	2.93	3.63	4.33
Ash	4.17	0.78	1.97	2.07	2.27
Fibers	8.51	1.61	2.17	3.57	4.21
Total carbohydrates	35.06	82.79	77.83	72.04	67.99

The minerals composition of date palm pollen and wheat flour 72% extract and their blends are shown in Table (3). The obtained results revealed that the date palm pollen constitute a reach source of mineral elements. The predominant minerals copper 319.6 mg/100g followed by zinc and manganese (309.4 and 284.0 mg/100g). Date palm pollen also contains useful amount of iron, potassium, magnesium and calcium (241.0, 160.0, 130.0 and 60.5 mg/100g, respectively). Moreover, wheat flour 72% extract had contained the highest amount of copper 426.2 mg/100g followed by manganese 219.0 mg/100g. Wherease, the blends were increased in minerals content by increasing addition of date palm pollen. Bacha *et al.* (1997) found that the pollen grains of date palm contain the macronutrients; N was present in the highest concentrations, followed by Ca, P, Mg and Na of the micronutrients, Fe was present the highest concentrations followed by Zn, Mn and Cu.

Table 3. Minerals content of raw materials and its blends (mg/100g).

Minerals content	Date palm pollen	Control	Blends		
			3 %	6 %	9 %
Copper	319.6	426.2	452.8	370.1	395.9
Potassium	160.0	57.4	66.9	74.1	81.8
Calcium	60.5	10.3	12.2	15.4	18.0
Magnesium	130.0	26.1	31.6	36.7	41.2
Iron	241.0	2.07	10.5	17.3	29.6
Zinc	309.4	1.24	13.5	27.1	30.8
Manganese	284.0	219.0	230.2	252.0	272.6

Organoleptic evaluation of the butter cake made from date palm pollen:

Data obtained in Table (4) for sensory properties showed that the control sample of butter cake made from wheat flour 72% extract had the highest degree (98.78%) of sensory acceptance. The same sensory acceptability resultant showed that in the butter cake made from wheat flour 72% extract and added the natural antioxidant from date palm pollen at 100, 200 and 300 ppm (95.44, 96.73 and 97.45 ppm, respectively). Sensory characteristics can be no variation by various concentrations of the ingredients in dough during production of butter cake prepared wheat flour 72% extract and it was added separately 3, 6 and 9% date palm pollen were acceptable to most members regarding to taste, odor, texture, color and general appearance.

Table 4. Effect of DPP and their extract on the sensory evaluation of butter cake

Types of additions	Taste 20	Odor 20	Texture 15	Crust color 15	Crumb color 15	General Appearance 15	Overall acceptability 100
Control	19.75 ^a ±0.56	19.50 ^a ±0.13	14.82 ^a ±0.66	14.90 ^a ±0.11	14.91 ^a ±0.80	14.90 ^a ±0.65	98.78
3 % DPP	18.95 ^a ±0.06	18.41 ^{ab} ±0.39	14.23 ^a ±0.92	12.85 ^c ±0.78	12.12 ^c ±0.07	13.98 ^b ±0.66	90.54
6 % DPP	17.57 ^{bc} ±0.23	18.00 ^b ±0.12	14.35 ^{ab} ±0.28	13.65 ^b ±0.48	13.68 ^b ±0.09	14.31 ^{ab} ±0.67	91.56
9 % DPP	19.15 ^a ±0.71	18.87 ^{ab} ±0.44	14.41 ^a ±0.06	13.12 ^{ab} ±0.85	12.45 ^c ±0.62	14.35 ^a ±0.16	92.35
100 ppm	18.40 ^b ±1.06	19.10 ^a ±0.12	14.25 ^a ±0.28	14.70 ^a ±0.47	14.42 ^a ±0.09	14.67 ^a ±0.67	95.44
200 ppm	19.00 ^a ±1.06	19.10 ^a ±0.63	14.32 ^a ±0.97	14.80 ^a ±0.74	14.63 ^a ±0.72	14.88 ^a ±0.63	96.73
300 ppm	19.30 ^a ±1.06	19.20 ^a ±0.93	14.35 ^a ±0.97	14.80 ^a ±0.74	14.89 ^a ±0.78	14.91 ^a ±0.99	97.45

Effect of storage period on peroxide value in butter cake blends:

The peroxide value is a good index for the quality of a fat. A refined fats should have peroxide value less than 1 millequivalent fat that have been stored for some period of time after refining may be found to have peroxide value of up to 10 millequivalent / kg oil (Rossell, 1983).

From the results in Table (5) it could be observed that the blends made from date palm pollen 6 and 9% and their extract at levels 200 and 300 ppm effectively inhibited to increase in peroxide value for four weeks period. Moreover, very close effects were observed for these blends. This means that date palm pollen and their extract contained antioxidants to which lipid peroxidation during storage.

Antioxidants are chemicals/materials that interact and deactivate the free radicals, therefore preventing them from causing harm. The prevention of actions of free radical is important step in the management of disease. Medicinal plants and their constituents play a vital and significant action to neutralize or inhibit the free radical

by the use of antioxidant activity. Experimental studies support the role of reactive oxygen species in cancer and dietary antioxidants as well as endogenous antioxidants shows a vital role as cancer preventive agents via neutralization of reactive oxygen species Borek *et al.* (1986). Another study also showed that plant phenolic compounds including flavonoids are effective antioxidants with reported anti-mutagenic and anti-carcinogenic effects Rice-Evans *et al.* (1997).

Table 5. Effect of storage period on peroxide value of butter cake blends.

Storage period/week	Control	Blends made from DPP			Blends with its extract DPP		
		3%	6%	9%	100 ppm	200 ppm	300ppm
Zero	2.12	2.12	2.12	2.12	2.12	2.12	2.12
One	4.79	3.45	2.64	2.42	3.12	2.28	2.18
Two	7.82	4.67	3.71	3.15	4.32	3.05	2.84
Three	10.35	7.23	4.95	3.98	6.53	4.67	3.77
Four	14.47	11.52	8.74	5.27	9.42	7.47	4.25

Biological activity in butter cake

Microbiological spoilage is often the major factors limiting the shelf life of bakery products. Spoilage from microbial growth causes economic loss for both manufacturers and consumer. These losses could be due to many individual cases such as, packaging, sanitary practice in manufacturing, storage conditions and product turnover (Saranraj and Geetha 2012).

Biological activity as total bacteria and fungi count were estimated in butter cake with date palm pollen at levels at level 3, 6 and 9% and their extract at 100, 200 and 300 ppm levels, respectively, during storage period for four weeks and the results are reported in Table 6. The results showed that the total count of bacteria for butter cake from DPP was ranged from 33.6 to 42.8×10^{-6} CFU and their extract of DPP had contained 32.2 to 40.4×10^{-6} CFU after four weeks and the total count of fungi was parallel to the bacteria count. According to their results, it is clear that there were a positive relationship between these polyphenols and antimicrobial effects.

The phenols especially tannins have ability to form hydrogen bonds with carbohydrates and proteins by inhibition of some enzymes in the living cell leading to inhibit growth of microorganisms including pathogenic bacteria. Also the activity of phenolic compounds belongs to other chemical families abundant in phenols such as free phenols, tannins derivatives and flavonoids Reed (1995).

Mold growth is by far the major factor limiting shelf life of high and intermediate bakery products. In general, mold growth on bakery products is a

serious problem that results in economic losses. Furthermore, losses of products due to mold spoilage are between 1 and 5 percent depending on the type of product, season, and the method of processing (Malkki and Rauha 2000).

Adjou *et al.* (2012) investigated the detection of spoilage fungi and mycotoxins contamination in butter cake product, popularly called "kulikuli". Forty five major markets were sampled and peanut cake products were analyzed. The results showed that the total coliform count ranged between 1.6×10^1 and 14.0×10^2 CFU g^{-1} , while the fungal count was ranged from 1.0 to 8.1×10^2 CFU g^{-1} and total bacteria count was between from 5.4×10^4 to 1.4×10^6 CFU g^{-1} . The high total bacterial and coliform count may have been as a result of the low level of hygiene maintained during the processing and sale of butter cake product. This includes the handlers, quality of ingredients used for dressing and the utensils. The open-air exposure of products, while they were displayed for sale, can also serve as source of contamination.

Table 6. Total bacteria and fungi count in butter cake made from date palm pollen during storage period

Types of additions	Total bacteria count $\times 10^6$ CFU			Total fungi count $\times 10^2$ CFU		
	One week	2 weeks	4 weeks	One week	2 weeks	4 weeks
Control	20.7	27.2	47.6	37.9	50.1	52.4
3 % DPP	20.5	27.4	42.8	36.5	49.3	51.3
6 % DPP	20.2	25.1	40.2	35.2	45.5	49.9
9 % DPP	19.5	23.3	33.6	30.9	37.4	39.2
100 ppm	19.8	25.4	40.4	35.3	46.5	49.8
200 ppm	19.1	22.2	39.9	33.8	44.6	47.1
300 ppm	18.7	21.5	32.2	29.5	36.9	37.4

From the obvious results it may be concluded that the date palm pollen and its extract are rich in protein, minerals and other essential antioxidant which may prevent the oxidative damages of shortening and antimicrobial activity. The addition of date palm pollen and its extract to butter cake gave acceptability product, safe and high nutrition value and quality.

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الإستفادة من حبوب لقاح نخيل البلح كمصدر طبيعى فى إنتاج مخبوزات وظيفية

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تمت الدراسة على حبوب لقاح نخيل البلح من الناحية الصحية لأعداد كيك دسم غذائى . مستخلص حبوب لقاح نخيل البلح يحتوى على فينولات عديدة وتم تفريدها بواسطة جهاز ال HPLC والنتائج أوضحت أن مستخلص حبوب لقاح نخيل البلح غنى بالمركبات عديدة الفينولات وهى الريبوتين- الأبيجينين- كيومارين وكانت نسبتها مرتفعة (١٥,٤٣-١٢,٢٦-١١,١٢ %) ويلي ذلك كلوروجنيك- أرثوكيوماريك- حامض الجاليك- الليتولين.

حبوب لقاح نخيل البلح ومستخلصها تم إضافتها على دقيق القمح ٧٢% أستخلص على نسب ٣- ٦- ٩% حبوب لقاح و ١٠٠- ٢٠٠- ٣٠٠ جزء فى المليون من مستخلص حبوب اللقاح ليعطى ستة خلطات. حبوب لقاح نخيل البلح ودقيق القمح ٧٢% أستخلص وخلطتهما تم تحليلهما من الناحية الكيماوية ومحتوى المعادن. أشارت النتائج الى أن حبوب لقاح نخيل البلح كانت مرتفعة فى نسبة البروتين - الدهون- الرماد والألياف (٣٢,٩٥- ١٩,٣١- ٤,١٧- ٨,٥١% على التوالي) وكلما زادت كمية حبوب اللقاح فى الخلطات زادت نسبة التركيب الكيماوى. النتائج الأتية من تحليل محتوى المعادن لحبوب لقاح نخيل البلح ودقيق القمح وخلطاتهم وجد أن حبوب اللقاح مرتفعة فى نسبة محتوى المعادن.

الصفات الحسية بالنسبة للكيك الدسم المجهز بواسطة دقيق القمح ٧٢% أستخلص كعينة قياسية كانت الأعلى فى نسبة القبول (٩٨,٧٨%) والخلطات الحضرة بأضافة مضادات الأكسدة كانت مرتفعة فى القبول الحسى مقارنة بالكيك الدسم المعد بأضافة ٣- ٦- ٩% حبوب لقاح. قيم البيروكسيد تم تقديرها فى الشورتنتنج المستخلص من الكيك الدسم المحضر بواسطة حبوب اللقاح ومستخلصها.

النشاط الحيوى وهو عد البكتريا والفطريات فى الكيك الدسم أثناء فترة التخزين لمدة أربعة أسابيع. أوضحت النتائج أن عد البكتريا فى الكيك الدسم المحضر من حبوب لقاح نخيل البلح يتراوح ما بين ٣٣,٦ الى ٤٢,٨ $\times 10^{-6}$ والكيك المحضر من المستخلص ٣٢,٢ الى ٤٠,٤ $\times 10^{-6}$ بعد أربعة أسابيع أما عد الفطريات فكانت نتائجه موازية للعد البكتيرى.

يمكن أن نوصى بأن حبوب اللقاح لنخيل البلح غنية بالبروتين والدهون ومتموى المعادن ومضادات الأكسدة الطبيعية. لذلك أضافة حبوب اللقاح ومستخلصها الى الكيك الدسم يعمل على تقليل فعل الأكسدة والنشاط الحيوى أثناء فترة التخزين وذلك لأننتاج مخبوزات غذائية وظيفية.