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Utilization of Ginger Powder (*Zingiber officinale Roscoe*) in Functional Food Production

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Abstract

The aim of this study is to utilize of ginger powder (GP) (*Zingiber officinale* Roscoe) in preparation of both cakes (3.0 and 6.0 %) and beef burgers (1.5, 3.0 and 4.5 %), respectively. Wheat flour 72% and 82% extraction was used in cakes. Also, chemical, physical, microbiological and sensory evaluation were investigated. In addition, beef burgers freezing and frozen storage period at -18^{0}c for three months. Results indicated that prepared cake formulae is considered as a good sources of crude fibers and ash content. Also, ginger powder was improved extensograph and farinograph parameters. Physical properties (weight, volume and specific weight) volume were improved due to the addition the gingers. Sensory evaluation was recorded highly acceptability score by the panelists, but formula which contained 3.0% GP was the best results. TBA values of prepared beef burgers showed that there are significant differences ($p \leq 0.05$) between control and other treatments. TBA values were decreased as the level of GP increased. The results of total bacterial counts were permissible limits and safe for human consumption. It could be concluded that ginger powder is considered as a good antioxidants and antimicrobial effect. Moreover, it could be used GP as functional foods.

Keywords: Antimicrobial, antioxidants, beef burger, cakes, functional foods, Ginger Powder, and sensory evaluation.

INTRODUCTION

Ginger (*Zingiber officinale* Roscoe), belongs to semitropic and tropical Zingiberaceae, that originated from South jap components of Asia and unfold to most of the planet regions. Ginger contains naturally active contents that embody the critical spicy codes, the shogaols and gingerols Singh *et al*., (2008).

Gingerols that are phenoplast in nature are answerable for the pungency of contemporary ginger. The chemical irritant is gift most profusely and a few alternative gingerols of shorter chains are also there in smaller quantitative relation. The sharp smell of ginger is thanks to shogaols, which is the dehydrated form of Gingerol. Gingerols are born-again to corresponding shogaols by heating Ali *et al*., (2008). Each gingerol and shogaols have high antioxidant activity Stoilova *et al*., 2007. The chemical irritant is understood for its vigorous antioxidant activity each in vivo and in vitro Kim *et al*., (2007). Also, it is rumored to cut back the chance of carcinoma, obesity, diabetes, cardiovascular diseases, cold related-diseases and arthritis Young *et al*., (2006) and Bailey-Shaw *et al*., (2008).

Ginger is offered as contemporary, dried, powdered, oleoresin, candy (crystallized ginger), preserved in brine or sweetener, and in oil kind. Ginger is an essential element of food formulations and process everywhere the world thanks to its biting style, refreshing pleasant aroma, and carminative characteristics. In the western world, it is used loosely for the aim of change of state in biscuits, gingerbreads, cakes, soups, puddings and pickles. In jap countries, contemporary ginger slices, chops, tiny items and ground ginger are extensively employed in non-vegetarian and feeder foods. Its usage in beverage preparation, pickling, confectionery and flavorer development is additional noted Vasala, (2001).

Spices and herbs are a part of food things for the development of aroma and flavor of food things and as functioning agents for antioxidative, preservative and antimicrobial Hathorn *et al*., (2008).

Meat and meat products are extremely perishable and have a brief shelf-life unless preservation strategies are used Olaoye and Onilude, (2010). This can be thanks to the fact that these products give the nutrients required to support the expansion of the many forms of microorganisms. Moreover, the chemical composition and physical characteristics of meat makes it an acceptable setting for microorganism growth Kalalou *et al*., (2004). However, shoppers are progressively exigent use of natural product as

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different preservatives in foods, because the safety of artificial additives has been a problem for many of the communities Zemenu and Kidist, (2016). Natural antioxidants are rumored to be a lot of convincing than the artificial once Bozkurt, (2006) and Valko *et al*., (2007).

Ginger may be an in style spice for a spread of foodstuffs as a food seasoning and fixings agents thanks to its sweet aroma and pungent style Pawar *et al*., (2007). Ginger contains up to three of a significant oil that causes the aroma of the spice Hara *et al*., (1998). Gingerol increases the motility of the epithelial Malu *et al*., (2009). Moreover, different students disclosed that ginger has antioxidant and antimicrobial activity in various foods Madsen and Bertelsen, (1995) and Takacsova *et al*., (2000).

The rhizome of the favoured ginger species, comment Officinale, is widely used as a spice and food seasoning thanks to its sweet aroma and pungent style. It is acknowledged to own antioxidant activity (Zia-ur-Rehman *et al*., 2003) and effective antimicrobial agents. A ginger rhizome extract exhibited the very best antioxidant activity (Mansour and Khalil, 2000) thanks to the results of its total phenols (Stoilova *et al*., 2007).

The results of plant extracts or essential oils classified as greatly recognized as safe (GRAS) (Solomakos *et al*., 2008).

The aim of this study is prepared cake formulae and beef burgers supplemented by Ginger powder with a different ratio. Moreover, these prepared products with high-quality nutritional value, acceptable for human consumption and safe from microbiological spoilage.

MATERIALS AND METHODS

The ginger was obtained from Bani Swaif, Research Station, Desert Research Center-Egypt. Flour (72 and 82% extraction), whole fresh egg, sugar, shortening, dry milk, baking powder, vanilla, cinnamon and salt (sodium chloride). Also, (ground beef meat**,** spices, white and black pepper, onion powder, garlic powder and salt) were obtained from the local market, Cairo, Egypt.

Preparation of ginger powder:

Fresh ginger roots (*Zingiber officinale* Roscoe) were washed with cold water, sorting, grading, peeling, slicing and drying (in an electric oven at 40°C). The ginger was ground into powder using a high-speed blender mill (25000/min), (WK-1000A; Qing Zhou Machinery Co., Ltd.), and then stored in polyethene bags at 4°C until analysis.

Preparation of cake:

Cake samples were prepared according to the modified method of Bennion and Bamford (1997). The control cake formula (C) was formulated from 100 g flour, 85 g whole fresh egg, 85 g sucrose, 55 g shortening, 3 g dry milk, 3.8 g baking powder and 0.6 g vanilla, (added 0.5 gram of cinnamon). The ginger powder was substituted with flour (72 and 82% yield extraction) at 3.0 and 6.0 %. To prepare the cake, sugar and shortening were creamed together using a kitchen machine (Mighty Setter-Electric Portable Hand Mixer – withstand and stainless-steel mixing bowl instructions, made in Japan). Flour, dry whole milk and baking powder were mixed together, then the mixture was added gradually to shortening, sucrose, egg, vanilla and beaten for 3 min using the mixing machine at low speed, then baked at 180^0C for 30 min. Baked cakes were left to cool for 1 hour at room temperature.

Preparation of beef burgers:

Four beef burger formulae were prepared from beef meat and replaced of beef meat by ginger powder with different ratio (1.5, 3.0 and 4.5%) as shown in Table (1)**.**

Each formula was mixed with all ingredients and formed into beef burgers using a burger forming machine (Expro. Co, Shanghai, China) with a diameter of 8 cm. beef burgers freezing and frozen storage period at -18^0c for three months.

Table (1): Ingredients (%) of formulated of ginger beef burgers.

Ingredients	**Ginger powder (GP) (%)**			
	Control	**G.P (1.5%)**	**G.P (3.0%)**	**G.P (4.5%)**
Lean meat	71.0	69.5	68.0	66.5
Added fat	10.0	10.0	10.0	10.0
Cold water	15.5	15.5	15.5	15.5
Salt	1.0	1.0	1.0	1.0
White pepper	0.2	0.2	0.2	0.2
Garlic powder	0.3	0.3	0.3	0.3
Onion powder	2.0	2.0	2.0	2.0
Ginger powder (GP)	0.0	1.5	3.0	4.5

(GP1.5%) is treatment with 1.5% G powder, (Gp3.0%) is treatment with 3.0% G powder and (GP4.5%) is treatment with 4.5% G powder.

Chemical Analysis:

The prepared ginger powder cake were analyzed for total ash, moisture, crude fiber, crude protein and ether extract, according to A.O.A.C. (2000). The difference determined total carbohydrate. For ginger beef burger samples, the pH was measured using digital pH meter, Total acidity was determined by A.O.A.C. (2005). Thiobarbituric acid (TBA) test was carried out according to the method described by Tarlagis *et al*., (1964). The TBA values were represented as mg malonaldehyde/Kg sample. Total viable count determined by ISO 4833-:(2013). Microbiology of the food chain –Hospital method for the enumeration of microorganisms -Part 1- Colony count at 30° C by the pour plate technique. Cairo University Research Park (CURP), Faculty of Agriculture, Cairo University.

Farinograph and extinsograph measurements:

Farinograph measurements for fine (72 and 82% yield extraction) flour and various flour formulae with quinoa flour were conducted using a Brabender Farinograph (Duisburg, Germany). The following parameters were determined: water absorption capacity (WA), dough development time (DDT), dough stability (DS), mixing tolerance index (MTI) and degree of softening (DOS) after mixing dough for 12 min after reaching the optimum. Extinsograph was used to record the following measurements; Elasticity(BU), extensibility (mm), proportional number (BU/mm) and energy of dough (cm^2) according to the method described by A.A.C.C. (2002).

Determination of the physical parameter of cake samples:

The weight and volume of prepared cake samples were measured after 1 hour of baking according to **A.A.C.C. (2002)**. The ratio of volume to weight was also calculated to obtain a specific volume.

Determination of color of cake samples:

The crust and crumb color of cake samples were determined using Chroma meter (Konica Minolta, model CR 410, Japan) that calibrated with a white plate and light trap supplied by the manufacturer at Cairo University Research Park (CURP), Faculty of Agriculture, Cairo University. Color was expressed using the CIE L, a, and b color system (CIE, 1976). Three spectral readings were taken for each sample, Lightness (L*) (dark to light), redness (a *) value (reddish to greenish) and yellowness (b*) values (yellowish to bluish) was estimated.

Storage of the Ginger beef burger:

Ginger burger was stored at refrigerator (-18⁰ C) until the analyses. They were analyzed immediately after processing for three months of frozen storage.

Sensory evaluation:

In order to evaluate the characteristics of the product and to access what variations of the product would gather better, sensory properties of cake samples were evaluated after cooling by 10 trained panellists from stuff members of Dessert Research Centre. Appearance, taste, odor, crust color, crumb color, crumb, texture and overall acceptability of prepared cake samples were evaluated according to the method described by **A.A.C.C. (2000)**.

Statistical analysis:

Statistical analysis was performed using one-way analysis of variance (ANOVA). All tests were conducted at the 5% significant level. **" SPSS" (1998)**, Statistics**,** version 20.

RESULTS AND DISCUSSION

Chemical composition of wheat flour (72% and 82% yield extraction):

Data in Table (2), illustrated the chemical analysis of raw materials (Wheat flour 72% and 82%) used in the preparation of ginger cake formulae. The chemical analysis of wheat flour 82% extraction rate was the highest content in moisture, protein and fibre 12.77%, 11.23% and 6.76%, respectively. Compared with wheat flour 72%, this result agreed with Attia *et al*., (2007) and Mahsa *et al*., 2015). Carbohydrate, ash and fat were the highest in wheat flour 72% (Cho 82.95%, 5.97 % and 3.50%), respectively, compared with wheat flour 82%, this result agreed with (Gomes *et al*., 2016).

Table (2): Chemical composition of both wheat flour (72% and 82% yield extraction) (g/100g) on (dry basis).

Samples	Values in %					
	Moisture	Protein	Fiber	Ash	Fat	Carbohydrates
Wheat flour 72%	10.56	4.08	3.50	5.97	3.50	82.95
Wheat flour 82%	12.77	11.23	6.76	0.97	1.78	79.26

Chemical composition of cake:

Data in Table (3) illustrated that an increase in the moisture content as levels of ginger powder increased up to 6.0%. The moisture content is an indication of the quality and stability of products. Higher moisture in ginger powder incorporated with cakes could be due to water holding capacity of powders. Protein, fibre and ash content were found to gradually increase by increasing the level of ginger powder in both 72 and 82%. The increase in protein, fat and ash contents of ginger powder incorporated cakes could be due to the presence of them in ginger Singh *et al*., (2012).

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Table (3): Chemical composition of prepared cake formulae fortified by ginger powder.

Cake samples	*Flour (72%)*			*Flour (82%)*		
	C	**GF 3.0%**	**GF 6.0%**	**C**	**GF 3.0%**	**GF 6.0%**
Moisture	19.09±3.02	19.78 ±0.53	21.38±0.53	17.5 ±1.49	18.62±.1.27	19.45±1.66
Crude Protein	7.14 ±1.71	7.22 ±0.18	7.56 ±0.24	6.38 ±0.35	6.94 ±0.31	7.14 ±0.74
Ether Extract	11.33±0.22	11.07±0.13	10.83±0.28	14.96±0.66	13.90±0.30	13.54±1.81
Crude Fiber	5.60 ±0.20	5.88 ±0.22	5.44 ±0.37	4.65 ±1.23	4.67 ±1.32	4.94 ±0.75
Total.Carbohydrates	55.2 ±1.94	54.3 ±3.8	53.0 ±6.01	54.8 ±1.1	54.1 ±1.8	52.9 ±1.3
Ash	1.64 ±4.92	1.75 ±5.25	1.79 ±5.37	1.72 ±0.54	1.77 ±0.48	2.03 ±0.72
Total.Calories	351.33	345.71	339.71	379.36	369.26	362.02

(C) is control cake, (GF3.0) is the cake treatment with 3.0% ginger flour, (GF6.0) is the cake treatment with 6.0% ginger flour. Mean values in the same raw / column followed by different letters are significantly different ($p\leq0.05$). Results as expressed as g l00 g dry weight basis.

Farinograph parameters of cake:

Data in Table (4) illustrated that the farinograph setting of prepared cake formulae containing ginger powder with different ratio of 3.0 and 6.0 %. The results showed that contained water observation in 72% was ranged from 60.4 to 62.6, and in 82% was ranged from 63.3 to 65.1, respectively. Arrival time was varied from 1.0 to 1.5 in 72% and in 82% was ranged from 1.0 to 2.0, respectively. Dough development time in 72% was ranged from 1.5 to 2.0, and in 82% was ranged from 1.5 to 3.0, respectively. Dough stability in 72% was ranged from 11.5 to 8.0, and in 82% was varied from 9.0 to 8.0, respectively**.** Degree of softening in 72% was ranged from 40.0 to 110.0, and in 82% was ranged from 50.0 to 70.0, respectively.

Table (4): Farinograph parameters of prepared cake containing ginger powder at different levels.

Cake Samples	**Water absorption (%)**	**Arrival Time (min)**	**Dough Development time (min)**	**Dough stability (min)**	**Degree of softening (BU)**
C(72 %)	60.4	1.0	1.5	11.5	40
GF3%(72%)	61.1	1.0	1.5	10.0	70
GF6%(72%)	62.6	1.5	2.0	8.0	110
C(82%)	63.3	1.0	1.5	9.0	50
GF3%(82%)	64.6	1.5	2.0	8.5	60
GF6%(82%)	65.1	2.0	3.0	8.0	70

(C) is control cake, (Gp3.0) is the cake treatment with 3.0% ginger powder, (Gp6.0) is the cake treatment with 6.0% ginger powder. Mean values in the same raw / column followed by different letters are significantly different ($p\leq0.05$).

Addition of ginger powder mainly increased the water absorption by increasing the ginger powder level from 0% to 6%. The highest increase in water absorption 62.6% in 72% and 65.1% in 82% were found with the addition of 6% ginger powder compared to that found in the control sample. These results are in agreement with Abou-Zaid *et al.*, (2011) reported that the differences in water absorption are mainly caused by addition fibre-rich matter, which retain more water. Abd El-Moniem and Yassen (1993), also, reported that the addition of fibre sources to wheat flour caused an increase in water absorption of the produced dough. This may be due to the higher water hydration capacity of the fibers.

On the other hand, the arrival time was increased from1.0 to 1.5 in 72% and from 1.0 to 2% in 82%, respectively by ginger powder increasing in the blend as compared with the other blends. A similar observation was noticed for the dough development time, there is increased from1.5 to 2.0 in 72% and from 1.5 to 3% in 82%, respectively by ginger powder increasing in the blends as compared with other blends.

On the contrary, dough stability is the most important index for dough strength and attributed to protein poor in sulfhydril groups, which normally caused a softening or degradation action of the dough noticed by Ismail (2007). The results showed that an increasing proportion of ginger powder in flour led to a progressive decrease in the dough stability (min) which was gradually decreased in 72% to 11.5,10.0 and 8.0 min, and in 82% was 9.0, 8.5 and 8.0. as the increasing levels of the ginger powder blends with 3 and 6%, respectively. These results are in agreement with those noticed by Abdel-Samie et al., (2010). They reported that the addition of ginger powder significantly decreases the dough stability as compared to the control sample. These results may be the variation in the additional levels of some components such as fiber or phenolic compounds. The degree of softening (Dough weakening), was observed that the degree of weakening values (BU) was increased by the increasing level of ginger powder from 3 to 6% in both 72% and 82% flour blends compared to control.

Extensograph parameters of cake:

Data in Table (5) showed that the effect of substitution of 3 and 6% flour in (72 and 82% yield extraction) with the same amount of ginger powder on extensograph measurements, i.e. extensibility (mm), elasticity (BU), proportional number (BU/mm) and energy of dough (cm^2). As presented data, it could be noticed that the resistance to extension (elasticity) of the dough showed a decrease. It was represented about 570 and 340 B.U in 72% and 340 and 280 in 82%, respectively. The amount of ginger powder improved by 3 and 6% ginger powder, respectively, as compared to the control sample. It observed that the dough extensibility of 6% ginger powder dough recorded the highest scores in comparison with control and other blends in 72%, and in 82% there is no change.

Table (5): Extensograph parameters of prepared cake containing ginger powder at different levels.

Cake samples	Elasticity (B.U)	Extensibility(mm)	Proportional number(BU/mm)	Energy(Cm^2)
C(72 %)	660	65	10.15	72
GF3%(72%)	570	60	9.50	64
GF6%(72%)	340	80	4.25	45
C(82%)	360	75	8.0	63
GF3%(82%)	340	75	4.53	47
GF6%(82%)	280	75	3.73	40

(C) is control cake, (GP3.0) is the cake treatment with 3.0% ginger powder, (GP6.0) is the cake treatment with 6.0% ginger powder. Mean values in the same raw / column followed by different letters are significantly different (p≤0.05).

The obtained data of the proportional number, the results in the same Table showed that the values were gradually decreased in the samples which were substituted with 3 and 6 % of ginger powder when compared to the control sample. These results are in agreement with Vadhera *et al*., (2004) and Ismail, (2007) who reported that the resistance to extension of the dough decreased as a result of increasing their fiber content that destroyed the gluten matrix in the dough, regardless of their higher content of protein as compared to the control sample.

Hamaker, (2001) mentioned that the decrease in energy and elasticity of dough affected by increasing the percentage of fiber, maybe due to the reduction of gluten as the percentage. In addition Carson and Sun, (2000) who they reported that addition of fiber resource to wheat flour produces marked negative effects on rheological properties of dough.

Physical measurements of cakes:

Data in Table (6) showed that the physical characteristics of prepared cakes, such as volume, weight and specific volume (cm^3/g), were affected by the rise of different ratio (3.0 and 6.0 %) of ginger powder.

Table (6): Physical measurements of prepared cakes supplemented by ginger powder.

Cakesamples	Weight (g)	Volume (cm^3)	Specific volume(cm^3/g)
C(72%)	41.67±2.52	79.0±9.64	1.89±0.133
GP3%(72%)	42.33±0.58	73.67±1.53	1.73±0.03
GP6%(72%)	43.0±2.0	71.67±7.64	1.67±0.100
LSD	4.27	16.19	0.22
C(82%)	42.0±1.0	68.67±0.58	1.64±0.04
GP3%(82%)	42.67±1.53	67.0±6.08	1.57±0.098
GP6%(82%)	43.0±1.0	66.33±0.58	1.55±0.05
LSD	2.72	8.02	0.15

(C) is control cake, (GP3.0) is the cake treatment with 3.0% ginger powder, (GP6.0) is the cake treatment with 6.0% ginger powder. Mean values in the same raw / column followed by different letters are significantly different (p≤0.05).

Results showed a significant increase in weight (P≤0.05) with increasing addition of ginger powder in relative to control cakes sample in 72 and 82% flour. The replacement of wheat flour with ginger powder caused a gradual decrease in cake volume in 72 and 82% flour. These results were mentioned by Sharma and Chauhan (2000). The values of specific volume followed a similar trend as that of size. The highest amount of specific volume was recorded for control cake. This finding is in agreement with that found by Aluko and Olugbemi (1989), who found lower volumes associated with composite flour as opposed to 100% wheat.

Color characteristics of cakes:

Data in Table (7) illustrate Color characteristics of prepared cakes supplemented by different ratio of ginger powder 3.0 and 6.0%. Regarding the L* parameters, it was observed that the higher the content of ginger powder in the formulation, the lower the levels of brightness of crust and crumbs in cakes, indicating lower light reflectance. This was due to the addition of ginger powder replacing wheat flour 72%, which gave a darker color to the final product. The results showed in 72% that lower L*, a* and b* values compared to the control were observed in a study by **Padilla *et al*., (2010)**. In relation to the crumbs, it was observed that a* and b* values increased in line with increased concentrations of ginger powder compared to the control.

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Table (7): Color characteristics of prepared cakes supplemented by ginger powder.

Cake samples	*Crust color*			*Crumb color*		
	L*	**a***	**b***	**L***	**a***	**b***
C(72%)	$55.79^{a}\pm0.67$	$13.45^{a}\pm0.57$	$34.58^{a}\pm0.39$	$55.89^{a}\pm0.40$	$5.37^{b}\pm.03$	$27.19^{b}\pm0.46$
GP3%(72%)	$55.18^{a}\pm0.59$	$12.17^{b}\pm0.15$	$34.14^{a}\pm0.5$	$55.18^{a}\pm0.27$	$5.07^{c}\pm.11$	$28.83^{a}\pm0.28$
GP6%(72%)	$54.69^{a}\pm0.39$	$12.31^{b}\pm0.22$	$33.65^{a}\pm0.11$	$52.41^{b}\pm0.16$	$5.63^{a}\pm.11$	$27.44^{b}\pm0.36$
LSD	1.27	0.82	0.84	0.66	0.20	0.85
C(82%)	$50.59^{b}\pm0.32$	$13.56^{a}\pm0.12$	$32.13^{a}\pm0.2$	$49.73^{a}\pm0.15$	$6.73^{b}\pm.12$	$27.33^{a}\pm0.56$
GP3%(82%)	$51.12^{ab}\pm0.1$	$13.39^{a}\pm0.23$	$32.16^{a}\pm0.17$	$48.85^{a}\pm0.78$	$7.12^{a}\pm.05$	$26.92^{a}\pm0.09$
GP6%(82%)	$51.67^{a}\pm0.27$	$12.76^{a}\pm0.71$	$32.48^{a}\pm0.26$	$49.3^{a}\pm1.27$	$6.76^{b}\pm.18$	$27.66^{a}\pm0.93$
LSD	0.56	0.98	0.49	1.96	0.29	1.42

(C) is control cake, (GP3.0) is the cake treatment with 3.0% ginger powder, (GP6.0) is the cake treatment with 6.0% ginger powder. Mean values in the same raw / column followed by different letters are significantly different (p≤0.05).

Sensory evaluation of ginger cake:

Data in Table (8) and figure (1**),** that **s**howed the organoleptic properties of cake produced by using wheat flour 72 and 82% yield extraction as a control sample. While the cake sample prepared by partial replacement of wheat flour with 3 and 6% ginger powder were evaluated to select the best substitution level for produce a high-quality cake. The cake samples were evaluated by ten trained of stuff members panelists for sensory properties (appearance, taste, odor, texture, Crust color, crumb color and Overall acceptability).

It can be concluded that all prepared cake replacement of 72 and 82 % yield extraction by ginger powder highly acceptable score of appearance, taste, odor, texture, curst color, crumb color and acceptability by the panellists. But formulae with 3.0% ginger powder gave more acceptable.

Table (8): Sensory evaluation of prepared cake supplemented different levels of ginger powder.

	Appearance	Taste	Odor	Texture	Crust color	Crumb color	Overall acceptability
C(72%)	8.5	8.5	9.0	8.5	8.7	9.0	8.7
GP3%(72%)	8.9	8.5	8.6	8.7	8.7	9.7	8.9
GP6%(72%)	8.5	7.7	8.2	8. 1	7.1	8.1	7.95
C(82%)	8.7	8.3	8.6	8.6	8.5	8.8	8.2
GP3%(82%)	8.8	8.2	8.9	8.5	8.5	8.7	8.7
GP6%(82%)	8.3	8.2	8.7	8.3	8.6	8.6	8.4

PH Values of ginger beef burger:

Data in Table (9) showed that the effect of the ginger powder with different ratio 1.5, 3.0 and 4.5% on the pH values of prepared beef burger during frozen storage time. It is evident from the results that the pH value of prepared beef burgers was decreased as the level of ginger powder increased, it was ranged from 5.16 to 5.16. The highest amount of pH was found in control samples and the lowest was in the sample contained 6.0% ginger powder.

Table (9): pH values of prepared beef burgers supplemented by ginger powder during the frozen storage period.

TBA"mg/Kg"	**Control(C)**	**GP 1.5%**	**GP 3.0%**	**GP 4.5%**
zero time	5.46±0.55	5.37±0.54	5.28±0.47	5.16±0.43
One month	6.06±0.45	5.99±1.34	5.46±0.42	5.35±0.56
Two month	6.31±0.13	6.26±0.59	6.25±0.59	5.99±0.26
Three month	6.42±0.14	6.35±0.14	6.32±0.19	6.14±0.25

(C) is control beef burger, (GP1.5) is the beef burger treatment with 1.5% ginger powder, (Gp3.0) is the beef burger treatment with 3.0% ginger powder, (Gp4.5) is the beef burger treatment with 4.5% ginger powder. Mean values in the same raw / column followed by different letters are significantly different (p≤0.05).

During frozen storage, pH values of prepared beef burger formulae were slightly increased as the prolonged frozen storage proceeded till reached between 6.14 and 6.42. These results are in agreement with those reported during refrigerated and frozen storage by McCarthy et al., (2001). The rise in pH may be due to the buildup of metabolites by bacterial action in meat and deaminations of proteins (Jay, 1996).

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Total Titratable Acidity (TTA) of ginger beef burger:

Data in Table (10) indicated that the acidity of prepared beef burgers supplemented by different ratio of ginger powder (1.5, 3 and 4.5%) during frozen storage period at -180 for three months. The obtained results revealed that there was significant (P≤0.05) difference between each treatment with a three-month storage period. When storage time increased from 0 to 3 month, the mean values of TTA contents were decreased from 2.26 to 1.21 for control samples. Moreover, when the storage time increased from 0 to three month the same pattern was also noticed with all treatments. This might be due the fact that preservative effects of ginger powder decreased through time. These results are in agreement with Fuzzati (2004) which stated that the antimicrobial properties of spices, in general, decreased when the number of storages increased.

Table (10): Acidity values period of prepared beef burgers supplemented by ginger powder during frozen storage period.

TBA“mg/Kg”	Control(C)	GP 1.5%	GP 3.0%	GP 4.5%
zero time	2.26±0.33	2.52±0.29	2.56±0.37	3.00±0.11
One month	2.11±0.71	2.13±0.36	2.42±0.43	2.89±0.26
Two month	1.27±0.38	1.46±0.25	1.60±0.32	1.88±0.53
Three month	1.21±0.05	1.35±0.08	1.51±0.14	1.76±0.25

(C) is control beef burger, (GP1.5) is the beef burger treatment with 1.5% ginger powder, (Gp3.0) is the beef burger treatment with 3.0% ginger powder, (Gp4.5) is the beef burger treatment with 4.5% ginger powder. Mean values in the same raw / column followed by different letters are significantly different (p≤0.05).

Thiobarbituric Acid (T.B.A) Values of ginger beef burger:

Data in Table (11) illustrated that the Thiobarbituric acid values in the beef burger with different ratio of ginger powder 1.5, 3.0 and 4.5% and frozen stored at -18^{0}C for three months. Thiobarbituric acid of the prepared beef burger was decreased as the level of ginger powder increased. TBA values were ranged between 0.99 and 1.23. This results may be due to that ginger has antioxidant inhibiting lipid oxidation throughout storage time. These results are in agreement with those mention by Estevez *et al*., (2004) and Djenane *et al*., (2005).

Table (11): Thiobarbituric acid values of prepared beef burgers supplemented by ginger powder during frozen storage period.

TBA“mg/Kg”	Control(C)	GP 1.5%	GP 3.0%	GP 4.5%
zero time	1.28±0.43	1.03±0.78	1.01±0.41	0.99±0.26
One month	1.39±0.42	1.30±0.49	1.14±0.42	1.10±0.29
Two months	1.88±0.27	1.35±0.46	1.24±0.28	1.20±0.61
Three months	1.95±0.13	1.44±0.11	1.31±0.04	1.23±0.15

(C) is control beef burger, (GP1.5) is the beef burger treatment with 1.5% ginger powder, (Gp3.0) is the beef burger treatment with 3.0% ginger powder, (Gp4.5) is the beef burger treatment with 4.5% ginger powder. Mean values in the same raw / column followed by different letters are significantly different (p≤0.05).

The total bacterial count of ginger beef burger:

Total count values of prepared beef burgers supplemented by different ratio of ginger powder 1.5, 3.0 and 4.5% and frozen stored at -18^{0}C for three months was tabulated in Table (12).

Table (12): Total bacterial count values of prepared beef burgers supplemented by ginger powder during frozen storage period.

TBA“mg/Kg”	Control(C)	GP 1.5%	GP 3.0%	GP 4.5%
zero time	8.8×10^5	6.1×10^5	5.7×10^5	4.7×10^5
One month	8.2×10^5	5.6×10^5	4.4×10^5	3.8×10^5
Two months	6.4×10^5	4.8×10^5	3.5×10^5	2.9×10^5
Three months	4.7×10^5	3.6×10^5	2.8×10^5	2.1×10^5

(C) is control beef burger, (GP1.5) is the beef burger treatment with 1.5% ginger powder, (Gp3) is the beef burger treatment with 3.0% ginger powder, (Gp4.5) is the beef burger treatment with 4.5% ginger powder. Mean values in the same raw / column followed by different letters are significantly different (p≤0.05).

Total bacterial counts of prepared beef burgers supplemented by ginger powder with different ratio 1.5, 3.0 and 4.5 % was ranged between 2.1×10^5 and 4.7×10^5 cfu/g . It is worthy to mention that total bacterial counts were decreased as the level of ginger powder increased. These results are in agreement with those found by Wakoli *et al*., (2014).

During the frozen storage period, the total bacterial count was gradually reduced as the storage time proceeded till reached between 4.7×10^5 and 8.8×10^5 cfu/g. This conclusion was in agreement by Emam (1990) and Igbinosa *et al*., (2009). This results due to the effect of freezing on microbial load.

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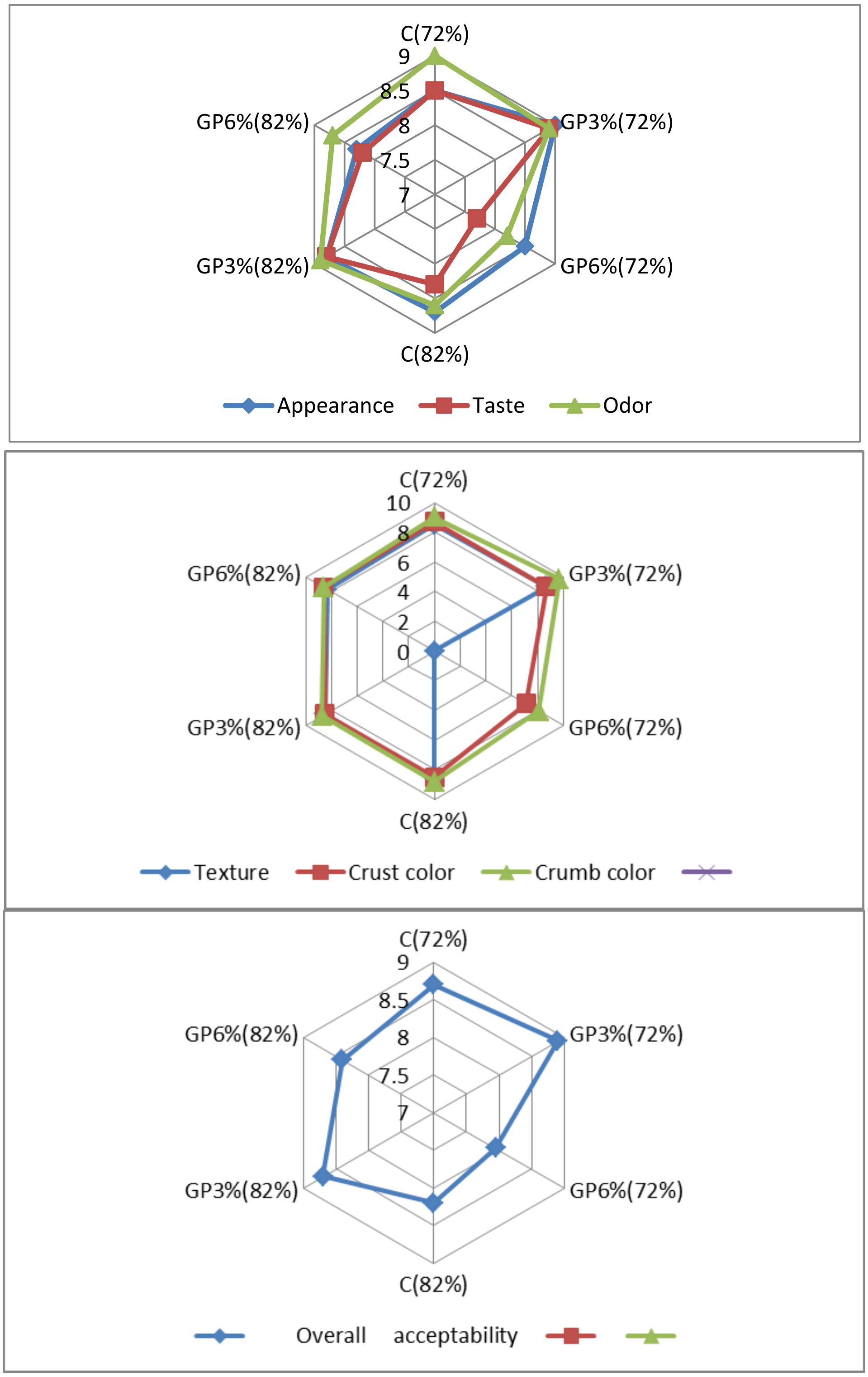

Fig. 1: Effect of ginger powder on sensory properties of cake.

CONCLUSION

It could be concluded from this study is to utilize of ginger powder (GP). First, used GP in preparation cakes (3.0 and 6.0 %), Wheat flour 72% and 82% extraction was used in cakes. Results indicated that prepared cake formulae are considered as a good source of crude fibers and ash content. Also, the ginger powder was improved stenograph and farinograph parameters. Physical properties volumes were improved due to the addition the gingers, formula which contained 3.0% GP was the best results. Second, used GP in beef burgers freezing and frozen storage period at -18^{0}c for three months. TBA values, total bacterial counts were decreased as the level of GP increased. It could be concluded that ginger powder is considered as a good antioxidant and antimicrobial effect. Moreover, it could be used GP as functional foods.

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