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Effect of cake fortified with pineapple consumption on hyperuricemic rats

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ABSTRACT

The present study was carried out to produce cake fortified with10% and 20% pineapple flour incorporated into wheat flour and also to investigate the hypouricemic effect of consumption of these cakes in potassium oxonate inducing hyperuricemic in rats. The nutritionally quality of pineapple flour indicated higher amount of ash and fibre and lower level of moisture, protein, fat and carbohydrate and higher values of potassium, iron, calcium, zinc and sodium than wheat flour72% dry weight. Fortification of cake with 10% and 20% pineapple flour could increase the values of ash, fiber and moisture in comparing with control cake. Cake fortified with 10 % pineapple gave somewhat similar sensory evaluation scores as control cake except crust colour that was lower. On the other side, the hyperuricemic rat group which consumed 20% pineapple cake showed non significant difference in growth and food values and appeared within normal values. Consumption of cake fortified with 10 and 20% pineapple cakes to hyperuricemic rat groups could lower the uric acid, creatinine and urea levels compared to control +ve group and showed non significant decrease in total protein, albumin, and globulin compared to control –ve group.

Key word: pineapple-nutritional value-cake-hyperuricemea- rats.

Introduction

Cakes are important bakery products, are consumed by different categories of people including the young and old, working class and children of school age. Cakes are always readily available and loved by children. Cakes normally combine some kind of flour (normally wheat flour), a sweetening agent (sugar), fats and liquid. They contain high levels of calories from sugar or fat with little protein, vitamin and minerals (Clerk and Herbert 2000 and Kolawole *et al*., 2013). Fortification is the nutritional improvement of food by the addition of nutrients such as vitamins, minerals and amino acids. Fortification was carried out with chickpeas, beans and milk, sesame protein soybean meal and fruits. Fortification strategies seeks to benefit in the shortest time, most of the population suffering from malnutrition, improving the quality of the food that make up the bulk of the diet (Abril *et al*.,2000).

Pineapple (*Ananas comosus*) is a tropical plant with edible multiple fruit consisting of coalesced berries. Pineapple is largely consumed around the world as canned pineapple slices, chunk and dice, pineapple juice, fruit salads, sugar syrup, alcohol, citric acid, pineapple chips and pineapple puree. Chunks of pineapple are used in desserts such as fruit salad, as well as in some savory dishes, including pizza toppings and a grilled ring on a hamburger. Crushed pineapple is used in yogurt, jam, sweets, and ice cream. The juice of the pineapple is popular and enjoyed over the world served as a beverage, and is also as a main ingredient in such cocktails (Deliza *et al*., 2005 and Fernandes *et al*., 2008). Pineapple is composed of nutrients which are good for human health and used as a medicinal plant. Pineapple contains the enzyme bromelain (protease) which has several therapeutic properties including malignant cell growth, thrombus formation, inflammation, control of diarrhoea, dermatological and skin debridement (Carvalho *et al*., 2008 and Tochi *et al*., 2008).

Overproduction of uric acid, characterised by hyperuricemia, is a common metabolic disorder and has been considered as an important risk factor for gout and may be associated with oxidative stress conditions (Strazzullo and Puig 2007).

So, this study aimed to throw light on the chemical composition of pineapple flour as well as evaluate the acceptance of some cakes fortified with 10 & 20% of pineapple. Also, this study included investigation of biological effects of consumption of these cakes on hyperurecemic rats.

Materials and Methods

Material:

Fresh pineapple, wheat flour 72% extraction, eggs, oil, skimmed milk, sugar, baking powder and vanillia were obtained from local market in Riyadh. Potassium oxonate and BioMeriuex Kits were purchased from El-Nil Company and Alkan Co. for Chemicals and Biodignostics. The standard diet was prepared according to

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NRC (1995). Fifty Sprague Dawley strain rats weighing 120 ± 5 g provided from experimental animals centre in Medicine collage of King Saud University in Riyadh.

Methods:

1- Preparation of pineapple flour:

Fresh pineapple fruits were peeled after wash by tape water and pressed the pulp using a manual press then lyophilized and grinded to fine powder to pass through a 60 mesh. The flour obtained was packaged in air-tight polypropolylene bags.

2- Analysis of wheat flour and pineapple flour:

Moisture, protein, fat, ash and fibre of experimental flours were determined according to the methods of the AOAC (2002). Total carbohydrates were estimated according to Nilsen (1994) as follows: Carbohydrates% = 100 - (% moisture+ % protein+ %fat +%ash). Some minerals as K, Fe, Ca, Zn and Na were also determined according to Pupsa *et al*., (1994).

3-Preparation of cake samples:

Table 1 showed the ingredients utilized in control cake and cakes fortified with 10% or 20% pineapple. 10 and 20% pineapples cakes were prepared by substitution of wheat flour with 10 and 20% pineapples flour.. At the first, egg, sugar, and vegetable oil were homogenized with an electric mixer at medium speed for 5 minutes; next, wheat flour, pineapple flour, vanillia, skimmed milk and water were added to the mixture. The mixture was homogenized until it was uniform in consistency, and the baking powder was added. The cake batter was placed into aluminum pans, previously oiled and sprinkled with wheat flour, and baked in a conventional oven pre-heated to 180 °C for 25 minutes. After cooling, the cakes were weighed and sliced. The samples were taken, wrapped in plastic bags, and kept in a freezer at –20 °C for further chemical analysis according to the method described by AACC (2002).

4-Chemical composition of experimental cakes:

The determination of protein, fat, ash, moisture, fibre and carbohydrate of dry basis control cake and 10% and 20% pineapple cakes followed the methodology recommended by (AOAC 2002).

Sensory analysis:

Sensory evaluation of the experimental cakes was conducted after two hours of preparation by 10 panelists according to the method of Lawless and Heymann (1998). The samples were labelled with three digit numerals and presented to consumers. Consumers evaluated shapeliness, crust color, crumb color, brightness of crumb, texture, softness, crust character, aroma and eating quality for all samples using nine point hedonic scales. Hedonic scale was in the following sequence: like extremely-9, like very much-8, like moderately-7, like slightly-6, neither like nor dislike-5, dislike slightly-4, dislike moderately-3,dislike very much-2, dislike extremely-1were evaluated.

5-Biological design:

After seven days of adaptation rats classified into 10 rats served as control -ve group which fed on standard diet only. Random blood samples from orbital canthus of the eye of the rest rats (40 rats) were taken for estimation serum uric acid levels befor and after 30 minutes of 250 mg/kg intraperitoneally potassium oxonate. The increase in serum uric acid levels at least 50% were considered hyperuricemic according to previous studies (Stavric and Nera 1978). Hyperuricemic rats were classified into four groups which were control (+ve) and three groups that consumed standard diets contain 25% of normal cake, 10% pineapple cake and 20% pineapple cake. Daily food intake and the weekly body weight gain were recorded. After 30 days, the rats were sacrificed to obtain blood for biochemical analyses.

6-Biochemical analysis of serum:

Serum uric acid, creatinine, urea, total protein, albumin and globulin were determined according to Fossati *et al*., (1980) Bonsens and Taussky (1984), Kanter (1975), Weichselbaum (1946), Doumas *et al*., 1977 and Henry (2001), respectively.

7-Calculation of FER and albumin /globulin ratio:

Food efficiency ratio (FER) was calculated (Chapman *et al*., 1950) while albumin /globulin ratio value was calculated according to Coles (1974).

8-Statistical analysis:

The data obtained from the experiments were statistically analyzed for analysis of variance (ANOVA) with single factor analysis using LSD of Statistical soft ware according to Abo-Allam (2003).

Results and Discussion

The proximate composition of wheat and pineapple flours was illustrated in table (2). The obtained results indicated that pineapple flour has lower level of moisture, protein, fat and carbohydrate and higher values of ash and fibre compared to wheat flour 72% dry weight.

The obtained results were agreed with Ahmad *et al*.,2001 who reported that the chemical properties of wheat flours have been studied previously by several researchers and they found that moisture content ranged between 12.5 to 14.6 %, crude protein content 8.23 to 12.71 % and ash content 0.42 to 0.66 (Ahmad 2001). The chemical composition of pineapple flour was agreed with Prakongpan *et al*., 2002 and Ackom and Tano-Debrah (2012).

Data obtained in table 3 showed that r of minerals content of pineapple flour had higher values of potassium, iron, calcium, zinc and sodium than wheat flour.

These results were agreed with Charles *et al*., 2013 who mentioned that pinapple fruit is rich in minerals especialy potassium.

Table 4 showed that the highest moisture content was found in the cake fortified with 20% pineapple flour, probably because the highest dietary fibre content can, through chemical interactions, retain water in the food matrix as the value of fibre reach 2.95 g/100g in addition to that the ash content was higher as the value was1.75 g/100g compared with other experimental cakes. The protein content was higher in control cake then in cake fortified with 10 % pineapple while the lowest content appeared in cake fortified with 20% pineapple flour. The fat content was in somewhat nearly in all experimental cakes. Fortification of cake with 10% pineapple flour could increase the values of ash, fibre and moisture in comparing with control cake. These obtained results were related to the proximate and physicochemical properties of pineapple flour which agreed with results of Charles *et al*., (2013). Supplementation of cake with pineapple retains the nutritional quality of cake. This is to meet the consumer demand for healthy, nutritious and natural products (Deliza *et al*., 2005).

The results concerning sensory evaluation of cake fortified with 10 and 20% pineapple used are shown in table (5). It could be noticed that control cake sample made from 100% wheat flour was characterized with high acceptability for all parameters. Cake fortified with 10 % pineapple gave somewhat similar scores as control cake except crust colour that was lower. Cake fortified with 20 % pineapple provided low grades of most than control cake.

These results could be explained by Mleko *et al*., 2012 who reported that an important component of wheat flour in bakery is the protein of the gluten that plays a decisive role in dough formation, gas retention and the structure of the crumbs. Pineapple mainly contains water, carbohydrates, sugars, vitamins A, C and beta carotene. It contains low amounts of protein, fat, ash and fibre. Sreenath *et al*., 1996 reported that sensory quality evaluation for *Ananas camosus* pineapple flour incorporated in sponge cakes had similar acceptability to control sponge cakes which is similar to that reported for cakes incorporated with pineapple

Table 6 showed that hyperuricemic control +ve rat group showed significant decrease in final weight, weight gain and FER at $P<0.001$ and also food intake at $P<0.05$ while hyperuricemic rat group which consumed normal cake showed lower in final weight, weight gain and FER at $P<0.05$ but hyperuricemic rat group which consumed 10% pineapple cake showed normal values except lower in weight gain at $P<0.05$ compared to control –ve group. The rat group which consumed 20% pineapple cake showed non significant difference in growth and food values and appeared wihin normal values. From the same table, it could be noticed that consumption of cake fortified with 10 and 20% pineapple cakes could increase the growth value and increase food intake compared to control +ve group.

According to Schneeman (1987), a 30 - 50 % soluble dietary fibre to 70 – 50 % insoluble dietary fibre is ideal to maintain good health. In the pineapple fruit, the fibre is contained in the pulp of the fruit which comprises the core and the fruit part. Fibre enhances digestive process, stimulates bowel movements, lowers cholesterol, and exerts a positive influence on blood sugar levels. The dietary fibres of pineapple helps alleviate constipation as an indigestible portion of plant food that pushes through the digestive system, absorbs water and ease defecation and changes the nature of the gastrointestinal tract by changing how other nutrients and chemicals are absorbed. It also has protein-digesting enzymes (bromelain) that thought to aid digestion (Prakongpan *et al*., 2002, Deliza *et al*., 2005 and Tochi *et al*., 2008).

Data in table 7 illustrated that hyperuricemic control +ve rat group and hyperuricemic rat group which consumed normal cake showed significant increase in serum uric acid ($P<0.01$&0.05,respectively), creatinine and urea ($P<0.01$) levels compared to control –ve group. Hyperuricemic rat group which consumed 10% pineapple cake showed non significant increase in serum uric acid and significant increase in serum creatinine and urea at $P<0.05$ while the rat group which consumed 20% pineapple cake showed non significant increase in serum uric acid and creatinine and significant increase in serum urea at $P<0.05$ compared to control –ve group. Consumption of cake fortified with 10 and 20% pineapple cakes to hyperuricemic rat groups could lower the uric acid, creatinine and urea levels compared to control +ve group.

It is known that potassium oxonate is uricase inhibitor associated with renal insufficiency and used for induction of chronic insufficiency. The oxonate treated rat can serve as a useful animal model not only in investigation of the uric acid nephropathy, but also in a number of other toxicologic evaluations connected with uric acid. This model has been used to evaluate possible therapeutic effects of cake fortified with 10% and 20% pineapple flour in certain disorders associated with uric acid (Strazzullo and Puig 2007). Pineapple peel extract may carry out these antioxidant activities by one or the following mechanisms: scavenging free radicals; interaction with oxidative cascade and preventing its outcome; singlet oxygen quenching; inhibition of oxidative enzymes and activation of antioxidant enzymes; and metal chelating (Perez-Tinoco *et al*.,2008 and Hale *et al*., 2010). Pineapple has the enzyme complex protease (bromelain). Bromelain contains peroxidase, acid phosphatase, several protease inhibitors and organically bound calcium and have anti-inflammatory properties as it blocks the formation of kinins which are responsible for inflammations (Vilanova- Neta *et al*., 2012).

Table 8 showed that hyperuricemic control +ve rat group and hyperuricemic rat group which consumed normal cake showed significant decrease in serum total protein ($P<0.01$&0.05,respectively) and globulin ($P<0.001$&0.01,respectively) and significant increase in Albumin/ Globulin ratio at $P<0.01$ compared to control –ve group. Hyperuricemic rat group which consumed 10 % and 20% pineapple cakes showed non significant decrease in total protein, albumin, globulin and Albumin/ Globulin ratio compared to control –ve group.

Administration of potassium oxonate, a well-known inhibitor of urate oxidase, is widely used to create an animal model of hyperuricemia. Elevated serum levels of uric acids results in the deposition of urate crystals in joints and kidneys causing uric acid nephrolithiasis and gouty arthritis (Chen and Xu 2003) The improvement effects were related to bromelain (protease) enzyme in pineapple which has several therapeutic properties and it could become more acceptable as a nutraceutical product (Tochi *et al*., 2008). Pineapple is an outstanding source of vitamin C, and the mineral manganese, both of which help protect against cell damage caused by free radicals. Manganese is also essential in producing several enzymes needed for energy production. Fresh pineapple is an excellent source of antioxidant vitamins as vitamin C which required for the collagen synthesis in the body. Collagen is the main structural protein in the body required for maintaining the integrity of blood vessels, skin, organs, and bones. It also contains small amount of vitamin A and beta-carotene levels. These compounds are known to have antioxidant properties. Studies have suggested that consumption of natural fruits rich in flavonoids helps the human body to protect from oxidants (Stinefelt *et al*., 2005 and Soha *et al*., 2009).

Table 1: Formula of control cake and experimental cake fortified with 10 and 20% pineapple

Ingredientsg/100g	Control cake 100WF	Cake fortified with 10% pineapple	Cake fortified with 20% pineapple
Wheat flour 72%	30.50	27.45	24.40
Eggs	15.30	15.30	15.30
Fat	10.30	10.30	1.30
Skimmed milk	1.10	1.10	1.10
Sugar	26.20	26.20	26.20
Baking powder	0.70	0.70	0.70
Vanillia	0.40	0.40	0.40
Water	15.5	15.50	15.50
Pineapple	-----	3.05	6.1

Table 2: Gross chemical composition of wheat flour and pineapple flour

Component%	Wheat flour 72% dry weight	Pineapple dry weight
Moisture	12.65	8.27
Protein	11.29	8.82
Fat	1.02	1.59
Ash	0.52	8.77
Fiber	0.73	31.8
carbohydrate	73.79	40.75

Table 3: Some minerals in wheat flour and pineapple (mg/100g)

Component%	Wheat flour 72% dry weight	Pineapple flour
Potassium	118.55	1080.55
Iron	2.55	3.33
Calcium	20.11	110.98
Zinc	0.81	1.14
Sodium	2.91	600.95

Table 4: Chemical composition of control cake and experimental cake fortified with 10 and 20% pineapple

Ingredients g/100g	Control cake 100WF	Cake fortified with 10% pineapple	Cake fortified with 20% pineapple
Protein %	13.30	11.97	10.64
Fat %	20.2	20.18	20.19
Ash %	1.25	1.59	1.75
Fiber %	0.95	1.83	2.95
Carbohydrate %	45.19	44.03	43.33
Moisture %	19.11	20.40	21.14

Table 5: Sensory properties of control cake and experimental cake fortified with 10 and 20% pineapple

	Shapeliness	Crust colour	Crumb colour (10)	Brightness of crumb(10)	Texture (10)	Softness (10)	Crust Character(10)	Aroma (15)	Eating quality (15)
Control cake	9.55± 1.71a	9.75± 1.11a	9.85± 1.20	9.55± 1.13a	9.70± 1.10a	9.80± 1.41a	9.75± 1.25a	14.50± 1.64	13.90± 1.50a
10% pineapple Cake	9.40± 1.22a	8.50± 0.78b*	8.70± 1.04a	9.2± 1.15a	8.6± 1.18a	8.5± 1.41a	8.8± 1.30a	12.4± 1.17ab	12.5± 1.16ab
20% pineapple Cake	8.50± 1.03a	7.50± 0.66b*	7.7± 0.70b*	7.2± 0.73b*	8.11± 1.21a	7.8± 0.46b*	7.4± 0.55b*	13.50± 1.35a	11.50± 1.44b*

Table 6: Mean values ± SD of growth performance and food intake of the experimental rat groups

Groups Variables	Control -ve	Control +ve	Normal cake	10% pineapple cake	20% pineapple cake
Initial weight(g)	120.55±3.11a	122.41±2.77a	121.77±3.14a	120.75±2.88a	123.41±3.11a
Final weight%	201.32±12.11a	155.18±6.40c***	183.48±7.88b*	190.97±9.11ab	196.86±8.77a
Weight gain(g/d)	80.77±6.22a	32.77±3.67d***	61.71±6.11c*	70.22±6.88b*	73.45±7.10ab
Food intake(g)	16.71±1.45a	13.51±1.21b*	15.22±1.30a	15.55±1.26a	15.95±1.34a
FER	0.161±0.006a	0.080±0.001c***	0.135±0.004b*	0.150±0.002a	0.153±0.003a

Significant with control (-ve) group * P<0.05 ** P<0.01 *** P<0.001
Values with the same letters in raw indicate non- significant difference (P<0.05) and vice versa

Table 7: Mean values ± SD of uric acid, creatinine and urea of the experimental rat groups

Groups Variables	Control -ve	Control +ve	Normal cake	10% pineapple cake	20% pineapple cake
Uric acid (mg/dl)	3.81±0.27cd	6.81±0.41a**	5.33±0.30b*	4.51±0.19c	4.11±0.21c
Creatinine (mg/dl)	0.70±0.05d	1.41±0.13a***	1.24±0.11ab***	0.95±0.03c*	0.81±0.05cd
Urea (μ /mg)	33.31±3.66c	52.71±5.14a***	48.43±5.11ab**	42.31±3.79b*	40.31±4.25b*

Significant with control (-ve) group * P<0.05 ** P<0.01 *** P<0.001
Values with the same letters in raw indicate non- significant difference (P<0.05) and vice versa

Table 8: Mean values ± SD of total protein, albumin and globulin of the experimental rat groups

Groups Variables	Control -ve	Control +ve	Normal cake	10% pineapple cake	20% pineapple cake
Total protein(g/dl)	7.53±0.55a	5.77±0.34c**	6.11±0.41bc*	6.50±0.61ab	6.66±0.73a
Albumin(g/dl)	3.50±1.25a	3.11±0.33a	3.22±0.31a	3.05±0.29ab	3.10±0.22ab
Globulin (g/dl)	4.03±0.46a	2.66±0.15d***	2.89±0.18c**	3.45±0.36ab	3.56±0.28a
Albumin/ Globulin	0.86±0.02b	1.16±0.10a**	1.11±0.08a**	0.88±0.01b	0.87±0.03b

Significant with control (-ve) group * P<0.05 ** P<0.01 *** P<0.001
Values with the same letters in raw indicate non- significant difference (P<0.05) and vice versa

Conclusion:

Pineapple flour could be considered as a nutraceutical to fortify wheat flour in cake processing. Cakes fortified with 10and 20% pineapple flour were acceptable, improve nutritional values and had hyporuricemic effects.

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