NUTRITIONAL EVALUATION OF SNACKS PREPARED USING TURMERIC AND CLOVE POWDERS

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Abstract:

In the present study, the effect of using Turmeric powders (TP) and Clove Powders (CP) at levels 5 and 10% on chemical composition, caloric values, sensory characteristics, physical properties, minerals, phenols, flavonoids, β- carotene content of prepared snacks were evaluated. Peroxide values for snacks were measured during storage period for 15 days at room temperature. Results indicated that addition of TP and CP at levels 5 and 10% increased the amount of ash, fibers, carbohydrate, minerals, total phenols, total flavonoids and β- carotene in prepared snacks samples, while protein and fat content decreased compared with control. Utilization of TP and CP in preparing resulted in delayed rancidity and improved shelf life of snacks. Total calories of snacks decreased with both TP and CP, while increased in control. Nutritional value of prepared snacks improved with using TP and CP. All prepared snacks samples were accepted. Sensory characteristics and physical properties were differed by changing TP and CP levels. It was concluded that utilization of TP and CP improved nutritional value s and increased shelf life of snacks and are recommended to be used as food additives to gain nutritional and healthy benefit.

Key words: Snacks, TP, CP, chemical composition, caloric value, , minerals, phenols, flavonoids, β- carotene peroxide values, sensory evaluation and physical properties.

Introduction

Turmeric, is a flowering rhizomatous plant belonging to the medicinal family of Zingiberaceae (**Amalraj *et al*., 2017)**. Turmeric contains many active components such as curcumin, turmerone, 1,8-cineole, zingiberene, ar-turmerone and ascorbic acid that have powerful antioxidant

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activities **(Dosoky *et al.*, 2019).** For its flavoring and digestive characteristics, turmeric (*Curcuma longa*) is extensively consumed. Curcumin, a phenolic yellow pigment is the key active component of turmeric. It has been traditionally used for centuries as a remedy for various disorders including the common cold, wounds, ulcers and liver disease (**Florentina *et al.*, 2021**). Turmeric (*Curcuma longa*) has been utilized traditionally as an anti-diabetic and has been proven important to posse high anticancer and antioxidant activity properties. The active components in turmeric, i.e. curcumin, which is a yellow coloring agent, present in the rhizomes of turmeric, and tetrahydro-curcumin (THC), which is the major colorless metabolites of curcumin, also possess anti-diabetic, anti-inflammatory, and antioxidant activity. In the scientific literature, a lot of information data is accessible with respect to the nutritional properties of turmeric and its utilization to develop sweet bakery products (**Lim *et al.*, 2011; El-Gohery and sahar 2020 and Shashanka *et al.*, 2020)**. Turmeric (*Curcuma longa*) is used as spice, preservative, colouring matter and has wide range of medicinal and pharmacological applications. It exhibits anti-inflammatory, antioxidant, anti-carcinogenic activities **(Abhishek and Dhan, 2008)**.Turmeric powder is used as a spice and is an essential component of curries. It also adds flavour and colour to rice, pasta, meat and vegetable dishes and salads **(Gupta *et al.*, 2013)**.Turmeric powder is a well-known spices containing natural antioxidants and especially yellow pigment of turmeric powder is a phenolic pigment, which is an antioxidant that can scavenge superoxide radicals, hydro-gen peroxide and nitric oxide **(Lim *et al.*, 2011)**.Turmeric antioxidant capacity is attributed to the curcuminoids and to a lesser extent, phenolic compounds, diarylheptanoids, phenylpropenoids and terpenes **(Li *et al.*, 2011 and Gonzales and Gómez, 2012)**.

Clove, Syzygium aromaticum, is an aromatic medical plant of the family Myrtaceae. It is commonly applied as a natural additive in the food industry, antiseptic against infectious diseases and local anesthetic in dentistry **(Cortés *et al.*, 2014)**.Clove, a plant whose flower buds are normally used as spice has attracted quite a lot of attention lately, following

its tremendous performance in terms of antioxidant property, compared with other spices **(El-Saber *et al*., 2020)**. Besides its pharmaceutical essence, studies conducted have indicated that cloves have very good nutritional composition **(Kumar *et al*., 2021)**.

Snacks became an important part of eating habits of the majority of the world ´s population. Basically, they were prepared from natural ingredients or different components according to predesigned perfect plans in order to yield products with specified functional properties in addition to health benefit for consumers **(Thakur and Saxena,2000).**Mostly snack are prepared by deep frying process and specially resemble the crispy texture and distinctive flavor. These snacks eaten lightly vary widely in their form and range from raw to cooked foods. Many snacks are processed by deep- frying as described by **Tortoe *et al* ., (2014).**

However, the effects of added TP and CP from different levels (5 and 10%) on the quality of snack samples have not reported so far. So, the aims of this work were to determine the effect of TP and CP on the nutritional content , shelf life and quality of snacks during storage period at room temperature.

Materials and Methods

Materials:

Turmeric and clove were obtained from local market at Kafrelsheikh city, Egypt . Commercial ingredients for baking were obtained from the same local markets.

Chemicals: Alpha-amylase, protease, amyloglucosidase, sodium metabisulfate, H_2SO_4, NaOH, HNO_3, Na_2SO_4, DPPH, Folin-Ciocalteu reagent, Gallic acid, β-carotene, methanol, ethanol, were purchased from Sigma-Aldrich Co. (St. Louis, MO, USA).

Methods:

Preparation of clove powder

Clove were powdered using a hammer mill (Moulinex, France) to obtain powdery form.

Preparation of snacks

Formulation of the snacks is stated on Table (A). The dry ingredient was mixed thoroughly for one minute by hand. The yeast and sugar dissolved in warm water (50 ml ,50 ºC), butter was added to the flour and cut in until the butter was broken into pieces. The yeast sugar mixture and egg were then added, mixed manually for 2 min and fermented for 2 h. The dough was shaped by new modification using (koma), fried the shaped snacks directly in corn oil **(Akubor , 2004).**

Table (A). Formula of the prepared snacks control and experimental snacks.

Ingredients	Control	Snacks With 5% T.P.	Snacks with 10%T.P.	Snacks with 5% C.P.	Snacks with 10%C.P.
Wheat flour	100.00 g	95.00 g	90.00 g	95.00 g	90.00 g
Sugar	12.50 g	12.50 g	12.50 g	12.50 g	12.50 g
Egg	23.90 ml	23.90 ml	23.90 ml	23.90 ml	23.90 ml
Butter	25.00 g	25.00 g	25.00 g	25.00 g	25.00 g
Yeast	2.50 g	2.50 g	2.50 g	2.50 g	2.50 g
Vanillia	0.30 g	0.30 g	0.30 g	0.30 g	0.30 g
Water	50.00 ml	50.00 ml	50.00 ml	50.00 ml	50.00 ml
TP	--------	5.00 g	10.00 g		
CP	--------	-------	------	5.00g	10.00g

Proximate chemical composition of prepared snacks

TP , CP and prepared snacks were analyzed for chemical composition. All analyses were carried out in triplicate. Moisture, crude protein, fat, ash and crude fiber content was determined according to **A.O.A.C.(1995).** Available carbohydrate content was calculated by difference **(Menezes *et al*., 2004).**

Caloric value of prepared snacks

Caloric value of prepared snacks was calculated according to **Lawrence, (1965).**

Caloric value (K.cal/100 g) = (protein+ carbohydrate content) x4 + (fat content x 9).

Estimation amounts of prepared snacks(g) consumed to cover children requirements of protein and caloric levels

Grams numbers consumed of prepared snacks to cover the daily requirements of energy for children (males 11-14 years) was calculated using the daily requirements for children (2500 k.cal.) as given by **FAO/WHO/UNU(1985).**

The G.D.R of energy (g) =

$$\frac{\text{Energy daily requirements of children (2500 k.cal./day)}}{\text{Energy value of snacks (k.cal./100g.)}}$$

Grams numbers consumed of prepared snacks to cover the daily requirements of protein for children (males 11-14 years) was calculated using the daily requirements for children (45g) as given by **N.R.C.F.N.(1989)**.

The G.D.R of protein (g) was calculated using the equation given by **FAO/ WHO/ UNU (1985)**.

$$\text{G.D.R of protein (g)} = \frac{\text{Protein daily requirements of children (45g/day)}}{\text{Protein content of snacks (g. / 100g.)}}$$

Minerals content of prepared snacks

The content of minerals such as sodium and potassium were determined by the flame photometry method reported by **(Jahan *et al.*, 2011).** Calcium, magnesium, iron and zinc were determined by flame atomic absorption spectrometry **(Kirk and Sawyer, 1991).**

Total phenols content of prepared snacks

Total phenols content of prepared snacks extracts were determined calorimetrically using Folin-Ciocalteau reagent according to the method described by **Mythili *et al.*, (2014**).

3 grams of each sample were dissolved in 25 ml of methanol 98%.The extracted sample (1 ml) was mixed with Folin-Ciocalteu reagent (1 ml with distilled water at a rate of 1:10) for 3 min then; 3 ml of 2% sodium carbonate (1 M) was added. The mixture was left at room temperature for 15 min, the polyphenolswere determined by an automated UV-VIS spectrophotometer at 765 nm and the results were calculated using a Gallic acid calibration curve (0–0.6 mg/ml). Gallic acid was used to set up the standard curve (Figure 1). The blank was prepared using the same procedure with 20µl of pure water in place of the extract. The results are expressed as equivalents to Gallic acid (mg GAE/g extract).

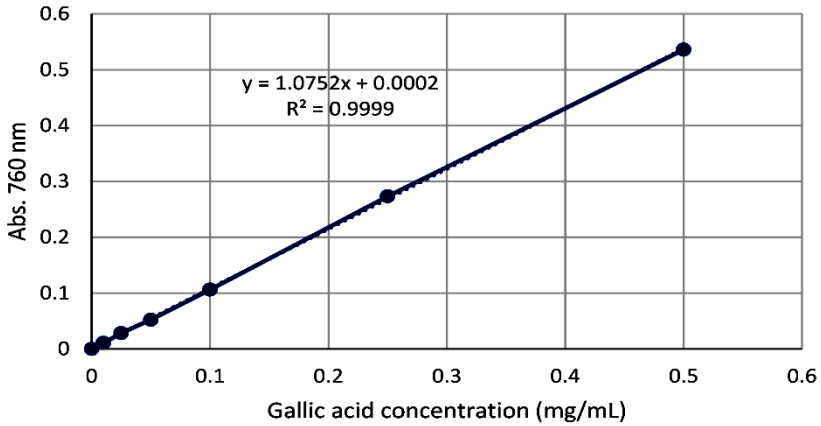

Fig. (1): Standard curve Gallic acid

Total flavonoids content of prepared snacks

Total flavonoids content of prepared snacks extracts were determined according to the method described by **Ebrahimzadeh *et al.*, (2010)** and **Nabavi *et al.*, (2009)**. 3 grams of each sample were dissolved in 25 ml of methanol 98%. 1 ml of extract was mixed separately with 1.5 ml methanol, 0.1ml of 10% aluminium chloride, 0.1ml of 1 M potassium

acetate and 2.8ml of distilled water. They then left at room temperature for 10min. The absorbance of the mixture was measured at 415nm on a UV/visible spectrophotometer. The quercetin (µg/ml) was used as a standard for the calibration curve.

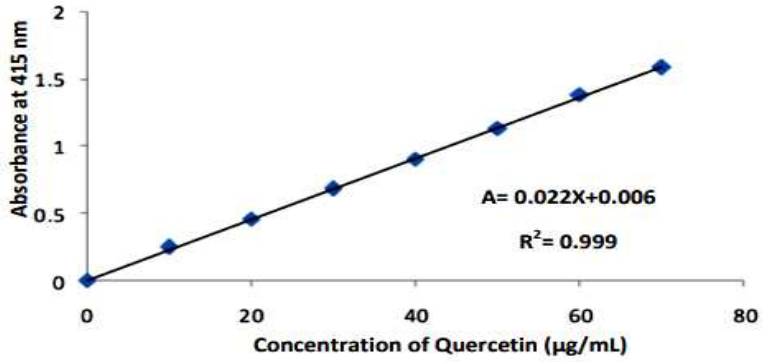

Fig. (2): Standard curve of Quercetin

Determination of β - carotene of prepared snacks

Standard preparation

The standard stock solution of (1000 ppm) concentration was prepared by dissolved the β – carotene in chloroform. The working standard solutions were ranged (10 - 80 ppm), were prepared in the same solvent and kept until analysis. The liner equation (Figure 3) is: y = 0.018 x, which is showing good linearity, precision, accuracy and sensitivity, which could be used for determination of β-carotene in prepared snacks samples.

Extraction of β-carotene

10 g of sample were transferred to volumetric flask, 10 ml of ethanol were added and the mixture was heated for 5 minutes. The mixture then filtered and the filtrate was kept in a conical flask, the crude was collected in the bottom of the flask in round-bottom bottle, then 10 ml DCM (Dichloromethane) was added. The solution was condensation for 5 min. Then separate the supernatant and add it to the first filtrate, this step was three times. The filtrate was collected in a separation funnel, then 10 ml of saturated NaCl solution was added, The contents were shaken gently then the lower layer were collected . Then 1 teaspoon anhydrous Na_2SO_4 was

added and allow standing for 5 min. The filtration of contents was carried out and the samples were transferred into a dark bottle (**Pavia *et al.*, 1976)**. The absorbance of the samples was prepared by spectrophotometer for β-carotene absorption at 460 nm according to **Souri *et al.*, (2005).**

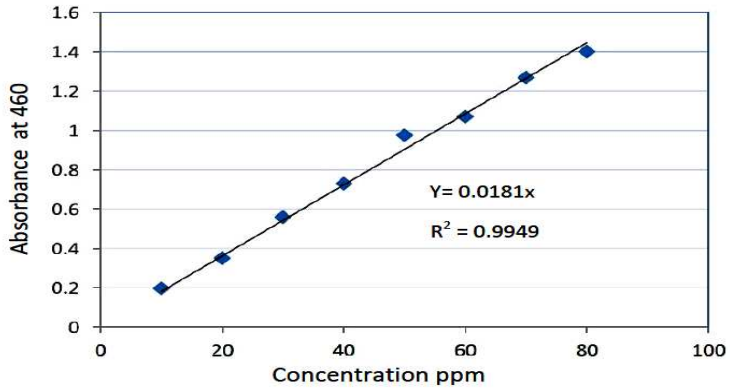

Figure 3: The standard curve of β-carotene

Peroxide Value (PV) of prepared snacks

Peroxide value of all samples was preceded by extract the oil from samples with ethanol absolute. Filtering and evaporation of the solvent, then PV was performed according to **A.O.A.C., (2016).** Two mg of the snacks extract were added and mixed in a solution containing chloroform-glacial acetic acid (30 ml, 3:2 v/v) and saturated thiosuphate (1 ml. 0.1M) until the disappearance of yellow color. PV (meq O_2/100g fat) was calculated by the following equation:

PV (meq O_2/1000g oil) = C × (V-V_0) × 12.69 × 78.8 /m.

Where: C: is sodium thiosulphate concentration (mol/l), V and V_O volumes of sodium thiosulphate blank respectively (ml) and m is the mass of snacks sample extracts (mg).

Sensory evaluation of prepared snacks

Sensory evaluation of prepared snacks was carried out with 20 panelists comprising of food stuff and postgraduate students from faculty of specific education, Kafrelsheikh University. Testing was done in the nutrition and food science laboratory. Each panelist was served with 5 randomly arranged snacks samples on a rectangular plastic tray. The 5

samples consisted of 4 types of substituted flour snacks and control (100% wheat flour). Water was provided for rinsing between the samples. Panelists were required to evaluate appearance, taste, flavor, internal color, external color, crispiness, texture and acceptance of the snacks using a 10- point hedonic scale **(Ihekoronye and Ngoddy,1985)**. **Physical evaluation of prepared snacks**

Prepared snacks were evaluated for weight, width, thickness, spread ratio and specific gravity . Snacks were weighted in grams after two hours from baking as described by method **A.A.C.C.,(2000)**.The width and thickness of snacks were measured to the nearest (mm) according to **A.A.C.C., (1983).** The spread ratio was calculated according to **A.A.C.C., (1983)**, as follows: spread ratio = width (mm) / thickness (mm). Specific gravity was determined according to **(Josln,1970).**

Statistical analysis

The mean and the standard deviation were calculated. The obtained data were subjected to analysis of variance one-way. The mean value of treatments was compared according to Duncan's multiple range tests. The data were analyzed using SPSS (version 28) according to **(Steel and Torrie ,1980)**.

Results and Discussion

Chemical composition of TP and CP

Chemical composition of TP and CP showed in Table (1). TP recorded higher value of protein than CP , as it recorded (6.60±0.0, 1.20±0.01), respectively for TP and CP. TP recorded higher value of ash , carbohydrates than CP , as it recorded (9.60±0.05, 64.21±0.02 , 5.10±0.01 and 51.62±0.01), respectively for TP and CP. CP recorded higher value of moisture, crude fat and fibers (10.20±.0.01,12.00±0.05, 19.88±0.05, 8.60 ±0.01, 4.88±0.10 and 6.11±0.01), respectively for CP and TP. TP recoded higher energy value (327.16±0.10) than CP (319.28±0.01) k.cal. /100g.

Turmeric contains *6.3%* proteins, 5.1% fat, 3.5% minerals, 69.4% carbohydrate, and 13.1% moisture.The major chemical compound in

turmeric is (5V) diaryl-heptanoid colouring material known as curcuminoids **(Tokusoglu *et al.*,2015 and Rohit *et al.*, 2014).**

Turmeric powder had **10.50% moisture, 10.80% ash, 3.82% crude fiber, 9.85% crude protein, 7.15% ether extract and 61.70% total carbohydrates** (Hassan, 2015)**.**

Gamaliel *et al* ., (2022) found that clove contained (24.56 ± 0.07 , 7.24± 0.12, 10.57± 0.22 , 1 6.33±0.00 and 36.02±0.24) g/ 100g , respectively for moisture, crude protein , crude fiber , crude fat and carbohydrates.

Ogunka and Mepba ,(2008) studied the chemical composition of clove , they found that clove contained (12.10± 0.3, 7.80±0.20, 1.10±0.1, 9.30±0.1 and 68.60±0.20) g/ 100g , respectively for moisture, crude protein , crude fiber , crude fat and carbohydrates.

Kaur *et al.*, (2019) found that clove contained (29.47± 0.08, 6.91±0.37, 14.37±0.04, 5.86±0.03 and 32.10±0.03) g/ 100g , respectively for moisture, crude protein , crude fiber , crude fat and carbohydrates.

Ayesha *et al.*, (2023) studied the chemical composition of clove , they found that clove contained (7.86 ± 0.04, 6.96±0.04, 5.04±0.12, 5.68±0.23, 29.97±1.99, 44.50±1.81) g/100 g , respectively for moisture, crude protein , crude fat , ash , crude fiber and carbohydrates.

Table (1): Chemical composition of TP and CP as (g/100 g D.B.) .

Chemical composition	TP	CP
Moisture	8.60 ±0.01	10.20±.0.01
Crude protein	6.60±0.02	1.20±0.01
Crude fat	4.88±0.10	12.00±0.05
Ash	9.60±0.05	5.10±0.01
Crude fiber	6.11±0.01	19.88±0.05
Carbohydrates	64.21±0.02	51.62±0.01
Energy (k.cal./ 100g)	327.16±0.10	319.28±0.01

D. B.:Dry Basis

Chemical composition of snacks prepared using TP and CP

The moisture content of any foods is normally considered as apointer of food quality and shelf life .It is significant to measure the moisture content of bakery products because of its potential impact on the physical, sensory and microbial properties of such items **(El-Gammal *et al.,* 2016**).Chemical composition of prepared snacks were showed in Table (2) . Results indicated that snacks prepared using 5% TP was the highest content of moisture (19.90 ± 0.60 g/100g), control was the lowest content (10.1±0.18 g/100g) . There were significant differences between snacks prepared using 5 , 10 % turmeric and 5,10 % CP.

Control was the highest content of protein (10.5±0.06 g/100g), there were no significant differences between control and snacks prepared using 5% TP in protein content, while there were significant differences between the other samples. The binary combination of wheat and turmeric decreased the protein content of the biscuit compared with control (**Adegoke *et al* ., 2017).** The highest value of fat was recorded in control (28.70±0.08 g/100g), while snacks prepared with 5 % TP recorded the lowest value (16.80±0.05 g/100g), there were significant differences between all samples in fat content .The highest value of ash content was recorded in snacks prepared using 10% TP and 10% CP as both recorded (1.00±0.02 g/100g),while the lowest value was recorded in control and snacks prepared using 5% CP as they recorded (0.60±0.02 and 0.06±0.01g/100g) ,respectively. These results was in the same line with **Adegoke *et al* ., (2017)** who found that increasing levels of the turmeric powder lead to the reduction of the fat content of the biscuit. The highest value of fibers was recorded in snacks prepared using 10% CP (1.90±0.03g/100g), the lowest value was recorded in control (1.10±0.07 g/100g).The same value was recorded in snacks prepared using 5% TP and snacks prepared using CP (1.20 ±0.02 g/100g),there were significant differences between control and the other samples. Carbohydrates content recorded the highest value in snacks prepared using 5% CP (53.00 ±0.18 g/100g), there were no

significant differences between control and snacks prepared using 10% CP, but there were significant differences between the other samples.

El-Gohery and Sahar, (2020) reported that turmeric powder contained 10.63% protein , 4.9 % fat , 9.62% ash , 6.13 % crude fiber and 68.73% carbohydrates. **Abdel-Moniem *et al* ., (2007)** found that clove contained (10.00± 0.006, 20.00±0.10 , 5.20±1.20±0.02, 12.10±0.45 and 51.50±0.02 g/ 100g , respectively for moisture, fiber, ash ,protein , fat and carbohydrates.

Marwa *et al* .,(2023) found that clove powder contained (9.17,13.50 ,6.40 and 6.17%), respectively for protein , fiber , fat and ash.

Using turmeric powder in the preparation noticeably enhanced the approximate chemical compositions and shelf-life of bun-bread. Therefore, turmeric powder could be deemed as a prospective health-boosting functional component **(Abdel-Latif *et al*., 2023).**

Table (2) : Chemical composition (g./100 g.) of snacks prepared using TP and CP at different levels compared with control.

Samples	Moisture	Crude Protein	Crude fat	Ash	Crude fibers	Carbohydrates
Control	10.10± 0.18 ^{e}	10.50 ± 0.06 ^{a}	28.70 ± 0.08 ^{a}	0.60± 0.02 ^{c}	1.10 ± 0.07 ^{d}	49.00 ± 0.19 ^{d}
Snacks prepared using 5% TP	19.90± 0.60 ^{a}	10.40± 0.20 ^{a}	16.80 ± 0.05 ^{e}	0.80± 0.04 ^{b}	1.20 ± 0.02 ^{c}	50.90 ± 0.23^{c}
Snacks prepared using 10% TP	18.60 ± 0.10 ^{b}	9.40± 0.30 ^{b}	18.20 ± 0.02 ^{d}	1.00 ± 0.02 ^{a}	1.40 ± 0.01 ^{b}	51.40 ± 0.19 ^{b}
Snacks prepared using 5% CP	15.10 ± 0.20 ^{c}	8.50 ± 0.06 ^{c}	21.60 ± 0.10 ^{c}	0.60 ± 0.01 ^{c}	1.20 ± 0.02 ^{c}	53.00 ± 0.13 ^{a}
Snacks prepared using 10% CP	14.50 ± 0.15 ^{d}	8.10 ± 0.02 ^{d}	23.60± 0.02 ^{b}	1.00± 0.02 ^{a}	1.90 ± 0.03 ^{a}	50.90 ± 0.18 ^{c}

Means followed by a common letter within the same column are not significantly different using Duncan's Multiple Range test at $p < 0.01$.

Caloric values of prepared snacks:

Data in Table (3) presented the caloric values of prepared snacks. Carbohydrates represented the main source of calories in major of samples

followed by fats, while protein was the lowest source of caloric value (496.30 k.cal/100g) was observed for control which had the highest value of fat caloric value (258.30 ,196.00 and 42.00 k.cal. /100g) ,respectively for carbohydrates , fats and protein , while the lowest caloric value was recorded for snacks prepared using 5% TP (396.40 k.cal/100g) that may be due to it contained the lowest value of fat caloric value (151.20 k.cal/100g).

Table (3): Caloric values (k.cal./100 g.) of experimental snacks and control.

Sample	Sources of calories			Total caloric values
	Protein	**Fat**	**Carbohydrates**	
Control	42.00	258.30	196.00	496.30
Snacks prepared using 5%TP	41.60	151.20	203.60	396.40
Snacks prepared using 10%TP	37.60	163.80	205.60	407.00
Snacks prepared using 5% CP	34.00	194.40	212.00	440.40
Snacks prepared using 10% CP	32.40	212.40	203.20	448.00

Estimation amounts of prepared snacks (g) consumed to cover daily children requirements of protein and caloric levels

As compared with **FAO/ WHO, (1985)** pattern, the results in Table (4) show the estimated amount of snacks samples to cover daily children requirements of protein and calories. The daily requirements of protein could be covered when consumed 428.57-555.55 g of prepared snacks for males (11-14) years. It was observed that control was the lowest consumed amount compared with the other samples. For calories , to cover daily children requirements need to consume 503.32-630.67 g of snacks daily . Snacks prepared using 5% TP showed the highest amount to cover daily children requirements of calories (G.D.R.630.67 g/day), it due to that it recorded the lowest caloric value 396.40 k.cal./100g (Table 3), while control showed the lowest value (G.D.R.503.72 g/day), it due to that it recorded the highest caloric value 496.7 k.cal./100g.

Table (4): The amount of prepared snacks (g) consumed to cover children daily requirements of protein and calories.

Prepared snacks	*G.D.R g of protein	*G.D.R g of calories
	** Males (11-14 years) (45 g)	** Males (11-14 years) (2500 k.cal.)
	grams of snacks	
Control	428.57	503.72
Snacks prepared using 5%TP	432.69	630.67
Snacks prepared using 10%TP	478.72	614.25
Snacks prepared using 5% CP	529.41	567.66
Snacks prepared using 10% CP	555.55	558.03

*G.D.R grams consumed of prepared snacks to cover the daily requirements for male children ((11-14 years) of protein and calories.
** Recommended levels of protein and calories according to FAO/WHO (1985).

Minerals content prepared snacks

Minerals content of prepared snacks included (Na, Ca, Mg, K, Zn and Fe showed in Table (5). It was observed that snacks prepared using 10% CP recorded the highest values of minerals , it was recorded (922.1461, 59.1254, 131.5873, 371.3892, 3.8361 and 3.8638 mg/100g,respectively for studied minerals , followed by snacks prepared using 5% CP as it recorded 808.3317, 51.8864, 124.2174, 362.0587, 3.6504 and 3.6914 mg/100g, respectively, snacks prepared using 10% TP and snacks prepared using 5% TP , respectively. It was noticed that fortification of snacks with TP and CP increased minerals content compared with control, it may be due to the content of minerals in used plants powder.

El-Refai *et al*.,(2021) studied the minerals content of turmeric powder, they found that it contained high values of potassium, calcium,

magnesium, iron and zinc (2486.43, 201.25, 194.32, 38.21 and 3.68) mg /100 g, respectively.

Restrepo *et al.,(*2020) studied minerals content of methanolic extract of turmeric , they found that it contained (4.14± 0.01, 0.24 ±0.01 and 3.5±0.13,), respectively for Ca, Mg, K and (444±2.3 , 19.34±0.43and 357±1.8) ppm , respectively for Fe, Zn and Na .

Table (5): Minerals content (mg/100g.) of snacks prepared using TP and CP at different levels compared with control.

Samples	Minerals (mg/100g)					
	Macro-elements				Micro-elements	
	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Potassium (K)	Zinc (Zn)	Iron (Fe)
Control	763.2205	34.1257	105.8214	342.9013	2.3184	3.0871
Snacks prepared using 5% TP	782.1154	39.2801	109.5841	351.3880	2.7641	3.2156
Snacks prepared using 10% TP	798.3569	43.8502	116.3157	359.3648	3.2119	3.4115
Snacks prepared using 5% CP	808.3317	51.8864	124.2174	362.0587	3.6504	3.6914
Snacks prepared using 10% CP	922.1461	59.1254	131.5873	371.3892	3.8361	3.8638

Total phenolic content of snacks prepared using TP and CP

Polyphenolic compounds are usually famous as the greatest phytochemical molecules which had contained natural antioxidant characteristics in the plants **(Andreu *et al*., 2018 and Zahoor *et al*., 2018)**.

Data in Table (6) showed total phenolic content values of prepared snacks. CP increased total phenolic content followed by TP, it recorded (317.801±4.31, 309.635±4.02, 235.993±4.28 and 192.866±3.58 mg GAE/g. There were significant differences between control and other trated samples. There were no significant differences between snacks prepared using 5 and

10 % TP, there were no significant differences between snacks prepared using 5 and 10 % CP.

El-Refai *et al*., (2021) found that total phenols increased with all addition of substitution raw materials (moringa and turmeric powder) (744.67 for TP.

Table (6): Total phenolic content of snacks prepared using TP and CP at different levels compared with control.

Samples	Total phenolic content mg GAE/g sample
Control	166.387±3.44^{a}
Snacks prepared using 5% TP	192.866±3.58^{b}
Snacks prepared using 10% TP	235.993±4.28^{bc}
Snacks prepared using 5% CP	309.635±4.02^{c}
Snacks prepared using 10% CP	317.801±4.31^{c}

a,b,c: For each parameter, different letters show significant differences at ($p > 0.05$).

Total flavonoids content of snacks prepared using TP and CP

Table (7) showed the total flavonoids content of prepared snacks. Snacks prepared using (5 and 10%) CP recorded the highest value of total flavonoids (93.345±2.56 and150.622±3.17 mg / g , respectively, followed by Snacks prepared using 10% TP (93.172±2.54). Control recorded the lowest value. There were no significant differences between control and snacks prepared using 5% TP, there were no significant differences between snacks prepared using 5% and 10% TP , there were significant differences between snacks prepared using 5% and 10% CP. It could be concluded that using tested plants increased flavonoids content .

Table (7): Total flavonoids content of snacks prepared using TP and CP at different levels compared with control.

Samples	Total flavonoid content mg QE/g sample
Control	83.245±2.14 [a]
Snacks prepared using 5% TP	89.909±2.38 [ab]
Snacks prepared using 10% TP	93.172±2.54 [b]
Snacks prepared using 5% CP	93.345±2.56 [b]
Snacks prepared using 10% CP	150.622±3.17 [c]

a,b,c: For each parameter, different letters show significant differences at (p > 0.05).

β – carotene content for snacks samples:

Table (8) cleared β – carotene content of snacks samples. Control recorded the lowest value of β – carotene (0.243 ± 0.01 mg/ 100g), while snacks prepared using TP and CP. It recorded that (0.361±0.02, 0.433±0.02, 0.510±0.03 and 0.612±0.03 mg/100g) , respectively for snacks prepared using 5% , 10 TP, 5% and 10% CP. There were no significant differences between control , snacks prepared using 5% , 10% TP . There were significant differences between snacks prepared using 5 and 10% CP. It was noted that the total phenolic compound increased with increase in the level of substitution of turmeric powder (**Adegoke *et al* ., 2017).**

Table (8): β – carotene content of snacks prepared using TP and CP at different levels compared with control.

Samples	β – carotene (mg/100g sample)
Control	0.243±0.01[a]
Snacks prepared using 5% TP	0.361±0.02[ab]
Snacks prepared using 10% TP	0.433±0.02[ab]
Snacks prepared using 5% CP	0.510±0.03[b]
Snacks prepared using 10% CP	0.612±0.03[c]

a,b,c: For each parameter, different letters show significant differences at (p > 0.05).

Peroxide value of prepared snacks during storage period

Table (9) showed the peroxide value of prepared snacks at zero time and during period for 15 days. Results indicated that peroxide value

increased during storage period from zero time to 15 days till after 15 days. Control was the highest peroxide values, as it recorded (5.1025±0.12 at zero time to7.0438±0.19 (meq O_2/1000 g oil) of samples after 15 days. Utilization of TP and CP in preparing snacks led to delaying rancidity, as it decreased peroxide value in all samples prepared using TP and CP during storage period compared with control. After 15 days, peroxide value range increased in all prepared snacks , as it ranged between (1.1109 to 1.9413**)** meq O_2/1000 g oil) of samples. There were no significant differences between controls ; snacks prepared using 5 and 10 %TP. There were no significant differences between snacks prepared using 10% TP , snacks prepared using 5 and 10 % CP at zero time . There were no significant differences between snacks prepared using 5, 10 %TP , snacks prepared using 5 and 10 % CP after 15 days . Peroxide value rate increased for control (1.9413) more that all treated samples.

Table (9) Peroxide values (PV) of experimental snacks samples during incubation period (days) at room temperature compared with control.

Samples	Peroxide Values (meq O_2/1000 g oil) of samples		Increase T_0-T_{15}
	(T_0) Zero time	(T_{15}) After 15 days period	
Control	5.1025±0.12 ^{b}	7.0438±0.19 ^{c}	1.9413
Snacks prepared using 5% TP	4.7851±0.11^{ab}	5.9241±0.13 ^{bc}	1.1390
Snacks prepared using 10% TP	4.4996±0.11^{ab}	5.6105±0.12 ^{b}	1.1109
Snacks prepared using 5% CP	4.1057±0.10 ^{a}	5.1278±0.12 ^{b}	1.0221
Snacks prepared using 10% CP	3.9329±0.11^{a}	4.7123±0.11^{ab}	0.7794

a,b,c: For each parameter, different letters show significant differences at ($p > 0.05$).

Sensory evaluation of snacks prepared using TP and CP

The organoleptic properties of prepared snacks included appearance , taste, flavor , internal color, external color, crispiness, texture acceptance. Data in Table (10) showed the sensory scores of prepared snacks evaluated by the panelists. It was noticed that control was the best type for appearance, flavor, crispiness and acceptance (9.10 ± 0.32, 8.50 ± 0.71, 9.10 ± 0.32 and 8.50 ± 0.71). Snacks prepared using 5% CP was the best type for taste , internal color and texture (8.20 ± 0.79, 8.10 ± 0.99 and 8.20 ± 0.79) , snack

prepared using 10% CP was the best type for external color (8.10 ± 0.74). There were no significant differences between all samples for all sensory characteristics compared with control. A 4% replacement of wheat flour with turmeric powder revealed satisfactory sensory results which were like the wheat-based bread sample **(Lim *et al.*, 2011).**

Table (10): Sensory evaluation of snacks prepared using TP and CP at different levels compared with control.

Sensory evaluation	Control	Snacks prepared using 5% TP	Snacks prepared using 10% TP	Snacks prepared using 5% CP	Snacks prepared using 10% CP
Appearance	9.10 ± 0.32 ^{a}	8.60 ± 0.52 ^{a}	8.80 ± 0.63 ^{a}	8.90 ± 0.57 ^{a}	8.80 ± 0.42 ^{a}
Taste	7.90 ± 0.99 ^{b}	7.60 ± 1.08 ^{bc}	7.70 ± 1.06 ^{b}	8.20 ± 0.79 ^{ab}	7.70 ± 0.95 ^{b}
Flavor	8.50 ± 0.71 ^{ab}	8.10 ± 0.74 ^{ab}	7.90 ± 1.1 ^{b}	8.30 ± 0.82 ^{ab}	8.00 ± 0.82 ^{b}
Inter color	7.90 ± 0.74 ^{b}	7.90 ± 0.74 ^{abc}	7.70 ± 0.95 ^{b}	8.10 ± 0.99 ^{ab}	8.00 ± 0.67 ^{b}
External color	7.80 ± 0.92 ^{b}	7.30 ± 0.82 ^{c}	7.30± 1.06 ^{b}	7.70 ± 0.95 ^{b}	8.10 ± 0.74 ^{b}
Crispness	9.10 ± 0.32 ^{a}	8.60 ± 0.52 ^{a}	8.80 ± 0.63 ^{a}	8.90 ± 0.57 ^{a}	8.80± 0.42 ^{a}
Texture	7.90 ± 0.99 ^{b}	7.60± 1.08 ^{bc}	7.70 ± 1.06 ^{b}	8.20 ± 0.79 ^{ab}	7.70± 0.95 ^{b}
Acceptance	8.50 ± 0.71 ^{ab}	8.10 ± 0.74 ^{ab}	7.90 ± 1.1 ^{b}	8.30 ± 0.82 ^{ab}	8.00 ± 0.82 ^{b}

Means followed by a common letter within the same row are not significantly different using Duncan's Multiple Range test at $p < 0.01$.

Physical properties of prepared snacks

Data in Table (11) cleared the physical properties of prepared snacks. Control recorded the highest value of weight (10.10 ± 0.12 g), while snacks prepared using 10% CP recorded the lowest value of weight (7.40 ± 0.40 g), there were no significant differences between control and snacks prepared using 5% TP for weight. There were significant differences between snacks prepared using 10% TP, snacks prepared using 5% CP and snacks prepared using 10% CP compared with control for weight . For width control recorded the highest value of width, followed by snacks prepared using 10% TP (3.10 ± 0.10 and 3.00 ± 0.05 cm), respectively. There were no significant differences between control and snacks prepared using 10% TP, while there were significant differences between control and

snacks 5% TP, snacks prepared using 5% CP and snacks prepared using 10% CP. For thickness, snacks prepared using 5% TP and snacks prepared using 5% CP (2.50 ± 0.1 and 2.50 ± 0.02 cm^3), respectively.

Table (11): Physical properties of snacks prepared using TP and CP at different levels compared with control.

Physical properties / Snacks	Weight g	Width cm	Thickness cm	Spread ratio	Specific gravity
Control	10.10 ± 0.12 [a]	3.10 ± 0.10 [a]	2.30± 0.37 [a]	1.35± 0.07 [a]	0.90±0.02 b
Snacks prepared using 5% TP	10.00 ± 0.06 [a]	2.30± 0.02 [b]	2.50 ± 0.1 [a]	0.92 ± 0.06 [d]	1.10 ± 0.03 a
Snacks prepared using 10% TP	8.30± 0.10 [c]	3.00 ± 0.05 [a]	2.40 ± 0.03 [a]	1.25 ± 0.05 [b]	0.80 ± 0.01 c
Snacks prepared using 5% CP	9.10 ± 0.06 [b]	2.40 ± 0.02 [b]	2.60 ± 0.02 [a]	0.92 ± 0.05 [d]	0.90 ± 0.02 b
Snacks prepared using 10% CP	7.40 ± 0.4 [d]	2.20 ± 0.22 [b]	2.10 ± 0.10 [a]	1.04 ± 0.07 [c]	0.80 ± 0.03 c

Means followed by a common letter within the same column are not significantly different using Duncan's Multiple Range test at $p < 0.01$.

Conclusion

It study concluded that, TP and CP can be partially substituted wheat at 5, 10 % in production of snacks to change the bad fast food concept and decrease of total calories, carbohydrates and increase ash and fibers for high nutritional value of snacks prepared with TP and CP. Utilization of TP and CP of increased shelf life as it reduced rancidity levels of snacks.

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التقييم الغذائى للاسناكس المحضرة باستخدام مسحوق الكركم والقرنفل

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الملخص العربي:

فى هذه الدراسة تم تقييم تأثير استخدام مسحوق الكركم والقرنفل بنسبة ٥ ، ١٠ ٪ على التركيب الكيميائى ، قيمت السعرات الحرارية ، الصفات الحسية ، الخصائص الفيزيائية ، محتوى الاملاح المعدنية ، الفينولات ، الفلافونويدات ، البيتاكاروتين للاسناكس المحضرة ، كما تم تقدير قيمة البيروكسيد للاسناكس خلال فترة التخزين لمدة ١٥ يوم على درجة حرارة الغرفة .وقد اشارت النتائج الى ان استخدام مسحوق الكركم والقرنفل بمستويات ٥ ، ١٠ ٪ ادى الى زيادة محتوى الرماد والالياف والكربوهيدرات والاملاح المعدنية والفينولات الكلية و الفلافونويدات الكلية والبيتاكاروتين فى عينات الاسناكس المحضرة بينما انخفض محتوى البروتين والدهون مقارنة بالعينة الضابطة.انخفضت السعرات الكلية للاسناكس مع كل من مسحوق الكركم والقرنفل ، بينما ازدادت ف العينة الضابطة . تحسنت القيمة الغذائية للسناكس المحضرة مع مسحوق الكركم والقرنفل .ادى استخدام مسحوق الكركم والقرنفل الى تأخير عملية التزنخ ، تحسين فترة الصلاحية للاسناكس المحضرة . وكانت عينات الاسناكس المحضرة جميعا مقبولة حسيا . وقد اختلفت الصفات الحسية والفيزيائية للاسناكس المحضرة باختلاف مستويات مسحوق الكركم والقرنفل المضافة . وقد تم التوصل إلى أن استخدام TP وCP أدى إلى تحسين القيمة الغذائية وزيادة العمر الافتراضي للاسناكس ويوصى باستخدامها كإضافات غذائية للحصول على فائدة غذائية وصحية.

الكلمات المفتاحية :الاسناكس ، مسحوق الكركم ، والقرنفل ، التركيب الكيماوى ، السعرات الحرارية ،الاملاح المعدنية ، الفينولات ، الفلافونويدات ، البيتاكاروتين ، قيمة البيروكسيد، التقييم الحسى ، الخصائص الفيزيائية .