Production of suggested healthy drinks using turmeric as a functional food for diabetic and its effect on the bone health

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Abstract

In this paper cold and hot drinks turmeric was carried out including turmeric tea, Latte coffee and some supplemented juice with turmeric including Carrot, Orange, and Lemon as functional foods for diabetic and its effect on osteoporosis. The drinks were prepared by adding 5 gm of turmeric powder without sugar and were evaluated sensory taste, color, flavor and texture by using 30 diabetes patients of female suffering from osteoporosis. The results showed that the drinks were acceptable and not significant differences P>0.05 compared to control drinks. Blood glucose and bone minerals improved after two month 124 ±1 mg/dL compared to blood glucose level before the test 170 mg/dL with improvement in the weight 90±0.5 compared to before the test 106±1.0, also bone minerals level as calcium, phosphorus and Potassium improved to 1.13±0.6 mmol/l, 4.2±0.2 mg/dl and 4.3±0.5 mmol/l compared to before the test 1.29 mmol/l, 3.05 mg/dl and 3.64 mmol/l. A combination turmeric in right proportions in fruit drinks and hot drinks is recommended as an alternative treat, flavouring and preservative.

Key words: Curcumin, turmeric, blood glucose, diabetic, osteoporosis, bone minerals and bone pain.

Introduction:

Diabetes is considered epidemic disease, it affected on over 400 million people worldwide **(International Diabetes Federation, 2017),** type 2 diabetes mellitus represents the most prevalent form **(World Health Organization, 2016).** But type 2 diabetes was controlled and prevented by using anti-diabetic drugs, lifestyle such as healthy diet and Physical activity (**Johnson et al, 2019).** Also people, who are suffering from prediabetes or type 2 diabetes mellitus (T2DM), modify lifestyle and pharmacologic **(American Diabetes Association, 2017).** Currently, medical plants was used to prevent and control type 2 diabetes **(Demmers et al, 2017 & Poolsup et al, 2019 & Suksomboon et al, 2011)**, Among these medical plants, Curcumin is the active substance in turmeric, it characterizes biological and pharmacological effects, include antioxidant, anti-inflammatory, anti-microbial, cardio protection, nephro

protection, anti-neoplastic, hepato protection, immunomodulatory, hypoglycaemic, anti-diabetic, anti-viral and anti-cancer activities and anti-rheumatic effects **(Mirzaei et al, 2017 & Derosa et al, 2016 & Nabavi et al , 2014 &Perrone et al, 2015).** Also curcumin has effect against diabetes, such as the study of **(Nishiyama, et al, 2005 & Stani, 2017)** investigated the impact of curcumin on animals suffering from diabetes, the experiment explained that curcumin have a medicine effect similar to thiazolidinedione, an anti-diabetic drug, this effect is due to the active substance curcumin 75%, emethoxycurcumin 20% and bisdemethoxycurcumin 5%. **(Francesca et al, 2019)** talk about curcumin and its relation to type 2 diabetes as a prevention and treatment, curcumin has medicinal properties such as anti-inflammatory, antioxidant, anti-carcinogenic, anti-bacterial activity like the influenza virus, hepatitis C virus, HIV and strains of staphylococcus, streptococcus, and pseudomonas, anti-fungal, antiulcer, hypotensive and hypocholesteremic **(Rahul Kumar Verma et al, 2018; Dimas Praditya et al, 2019)**. Also **(Rohith N.Thota et al, 2018)** investigated curcumin alleviates postprandial glycaemic response in healthy subjects, the results were showed decreasing in glucose concentrations with percent 60.6% for persons fed on curcumin and decreasing glucose concentrations with percent 51% for persons fed on curcumin+fishoil compared with placebo. Turmeric can treat osteoporosis and improving bone minerals level as the study of **(Yang MW, Wang TH et al, 2011)** carried out the natural substances such as curcumin can prevent and treat osteoporosis. Consumption of curcumin and alendronate has an effective impacts on bone mineral density (BMD) for women with osteoporosis due to postmenopausal, the results are showed increasing BMD in four areas compared to the control and alendronate groups**.** Also curcumin is considered a natural anti-microbial agent against over 100 strains of pathogens, good antioxidant gent, anti-inflammatory, anti-bacterial and anti-fungal **(Fatemeh Khanizadeh et al, 2018; Artur Adamczak et al, 2020)**. according to **Homa Hodaei et al, (2019) and Nalinee Poolsup et al, (2019)** reported the effectivenes consumption of curcumin supplementation (1500 mg) on insulin resistance and oxidative stress for patients with type 2 diabetes, the results are showed positive effects in reducing fasting blood glucose level (from 11.7 mg/dL to 1.3 mg/dL) and reducing weight with improvement lipid profile**. (Jia He etal, 2020)** investigated the possibility of using curcumin for bone regeneration under high glucose levels. Curcumin involved in bone remodeling, and it can be affect the skeletal system, alleviates osteoporosis and may be a therapeutic effect of osteoporosis (**Ramin Rohanizadeh1, 2016 & Zhiguang Chen et al, 2016)**.

Material and methods

Patient selection and source of materials

- Dried turmeric not powder, black pepper, fruits and milk used in the work were collected from market from Cairo, Egypt.

-The study's participants, 20 diabetic of women suffering from osteoporosis, 45 - 50 years of age were recruited for this study, height 165 Cm, Actual weight was 95 kg, perfect weight was 65 kg and body mass index was 34 kg/m^2, patients known to be diabetic for 1 year, suffer from high blood glucose level and osteoporosis.

Preparation of the turmeric and drinks

-Turmeric and black pepper were prepared by grinding in the blender to get powder, 5gm of turmeric and little of black pepper were added to juice of carrot, orange, lemon, tea and latte coffee.

Sensory evaluation: Twenty diabetic women, suffering from osteoporosis, were used for the sensory evaluation of the turmeric drinks using a 5-point hedonic scale, blood glucose level and osteoporosis analysis is performed for them. The Scientific Research Ethics Letter No. EC 2302 was obtained from the Scientific Research Ethics Committee at Fayoum University.

Study design of diabetic and suffered from osteoporosis

-The study design was lasted 2 months. The patients were drinking the turmeric drinks as turmeric tea, turmeric coffee, Carrot Juice, orange Juice and Lemon juice.

-Diabetes was diagnosed according to WHO, blood glucose level more than (120/80 mg/dL) was classified as Diabetic or hyperglycemia.

- Osteoporosis was diagnosed by bone mineral densitometry according to WHO, Bone density (<-2.5) was classified as osteoporosis.

Sample Collection

Blood samples were collected from patients at the beginning of the study and after 8 weeks with and without drinks supplemented with turmeric. Blood samples were collected in EDTA vials. Plasma was separated by centrifugation (3000 rpm) for 10 min, and then blood glucose was determined, bone mineral, HDL, LDL, VLDL level were measured in plasma. Also some biochemical parameters were determined in Tumeric.

BMD measurement and calcium, phosphorus, potassium analysis

BMDs of femoral neck and total hip were determined by using dualenergy X-ray absorptiometry at the beginning of the study and after 2 months using Hologic and Waltham. The study defined osteoporosis according to (WHO). The analysis of Ca, P, and K were (1.29 mmol/L, 3.05 mg/dl, 3.64 mmol/L), these data were showed decreasing in the bone minerals and osteoporosis.

Determination of proximate composition

Moisture, protein and fiber were determined according to **James, (1995)**. Total ash content was determined according to **AOAC, (2000)**. Fat content of the sample was determined according to **Pearson, (1976)**.

Phytochemical Screening

Alkaloids and sterol were determined according to **Haborne, (1998)**. Saponins were determined according to **AOAC, (2000)**. Flavonoid was determined according to **Haborne, (1998)**. Phenol and Tannins were determined according to **Person, (1976).**

Alkaloid test

1.0 ml of extract with 5.0 ml of concentrated HCl (2%) on a steam bath and filtered to 1 ml, Wagner's reagent was added, the presence of reddish brown indicated to Alkaloids.

Saponins test

1 ml of the filtrate was diluted in 1ml of water, with the shaken vigorously, strong Frothing indicated to Saponins.

Tannins test

Addition of 5 ml of the extract to 2 ml of HCL concentrated (1%). The result is the presence of a red indicated to Tannin.

Sterol test

1 ml of the extract was dissolved in 2 ml of chloroform, and then 1 ml of concentrated H_2So_4 was added. The presence of reddish brown colour indicated to Steroid.

Phenol test

1 ml of the extract was added with 1 ml of $Fecl_2$ concentrated (10%). The presence of a greenish brown indicated to a phenolic nucleus.

Flavonoid test

1 ml of the extract was diluted in 1 ml of diluted NaOH. The presence of precipitate indicated to flavonoid.

Determination of vitamins

Riboflavin, thiamine and niacin were determined according to **Onwuka, (2005).**

Determination of minerals

Calcium, phosphorous, potassium and iron were determined according to **James, (1995).**

Table 1: Composition of ingredients in turmeric drinks

Drinks	**ingredients in drinks/gm - ml**					
	Fruit	Sugar/ gm	Water ml	low fat milk ml	Turmeric gm	Black pepper gm
Turmeric tea	_	No	200 ml	_	5	2 gm
Turmeric coffee	_	No	_	50	5	2 gm
Carrot Juice	3	No	25	_	5	2 gm
orange Juice	2	No	25	_	5	2 gm

Lemon juice	1	No	200	_	5	2 gm

Statistical analysis of data Results and discussion

The data presented as the mean ± standard deviation and frequency. ANOVA were applied for comparison of the results and statistical analysis was performed by using software SPSS 19 at P value < 0.05 is considered significant.

Results and Discussion

Sensory evaluation mean of turmeric drinks

Data in **table 2** explains the sensory evaluation mean of turmeric drinks as, curcumin tea, curcumin coffee, carrot juice, orange juice, lemon juice. The results shows that there was no significant difference (P>0.05) in sensory evaluation properties, also these drinks were achieved good results in taste, color, Aroma, texture and general acceptability (4.64, 5, 4.98, 5 and 4.9) , so it was acceptable compared to control and commercial drink used as standard **(Ehirim et al, 2006).** These results agreed with **(Ankitha et al, 2018)** reported that the developed product "beverage formulation with curcumin fortified" was rich in antioxidant activity and curcumin level; sweetener and flavor were acceptable for consumer. Also, developed product can be considered as beneficial and highly nutritional in functional properties. Turmeric could be an excellent supplemented nutritional due to the high content of protein and carbohydrates, addition to some essential minerals and the antioxidant activity, so it makes as functional foods and prevention for chronic diseases such as diabetics, blood pressure and osteoporosis **(Jaime Restrepo-Osorio et al, 2020).** Preparation of pineapple drinks flavoured with different levels of turmeric and ginger. The sensory evaluation results of the drinks was acceptable and good compared to the commercial pineapple drink used as standard **(Ekeledo, et al, 2014).**

Table 2: Sensory evaluation mean of turmeric drinks

Sensory evaluation / Juice samples	**Taste “ 5 ”**		**Colure “ 5 ”**		**Aroma “ 5 ”**		**Textures “ 5 ”**		**general acceptability “ 5 ”**		
Turmeric tea	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**Mean**
	5	4	5	5	5	4.5	5	5	5	4.7	4.64
Turmeric coffee	5	5	5	5	5	5	5	5	5	5	5
Carrot Juice	5	5	5	5	5	4.9	5	5	5	5	4.98
orange Juice	5	5	5	5	5	5	5	5	5	5	5
Lemon juice	5	4.8	5	5	5	4.8	5	4.9	5	5	4.9

C: mean control sample T: mean test sample “with curcumin”.

Proximate composition of Turmeric

The results in **Table 3** shows that the turmeric contains 9.63% protein, 66.81 % carbohydrates, 6.82% oil, 2.86% ash, 8.87% moisture

and 7.48% fiber, so it could be a rich source of protein, fiber and carbohydrate **(Jaime Restrepo-Osorio et al, 2020)**. The high content in ash is responsible for increasing mineral level in Turmeric. The role of fiber in Turmeric will help to prevent the absorption of excess cholesterol, hypocholesteremic and diabetes mellitus **(Ikpeama, Ahamefula, et al, 2014 & Bamishaiye et. al., 2011).**

Table 3: Proximate composition of Turmeric

Parameters	Contents %
Protein	9.63
Carbohydrates	66.81
Oil	6.82
Ash	2.86
Moisture	8.87
Fiber	7.48

Values are means ± standard deviation of three determinations

Vitamins and mineral composition of Turmeric mg/g

The results in Table 4 shows that turmeric has 3.46 A, 1.25 B2, 0.38 B3, 0.89 C, 0.68 D, 1.63 Ca, 1.31 K, 1.08 P, 0.755 S and 0.0665 mg/g Fe, with constant feeding on turmeric plant could form strong bones, decreasing of blood pressure and patients with soft bone offer them meals with high calcium and potassium **(Kubmarawa et al., 2007)**. According to **Imoru et al, (2018)**, turmeric contains high amount of protein, carbohydrates, vitamins and minerals.

Table 4: Vitamins and mineral composition of Turmeric mg/ g

Vitamins	Contents	Minerals	Contents
Vit. A	3.46	Ca	1.63
Vit. B2	1.25	K	1.31
Vit. B3	0.38	P	1.08
Vit. C	0.89	S	0.755
Vit. D	0.68	Fe	0.0665
Vit. E	0.43	Cu	0.0455

Values are means ± standard deviation of three determinations

Phytochemicals composition of Turmeric mg/ g

The results in **Table 5** shows that turmeric plant is excellent content in phytochemicals, it had 1.33 Tannins, 0.078 Phenols, 0.48 Sterol, 0.56 Flavonoids and 0.743 mg/g Saponins, this compounds indicated to the medicinal properties of turmeric, so it had antioxidants and antimicrobial properties, Saponins and Tannins prevents the development of microorganisms and have antifungal properties **(Ikpeama et al, 2014; Iniaghe et al., 2009; Prasad et al., 2008; Okwu and Josiah, 2006).** Due to the nutritional value and phenolic compounds

contents, turmeric makes as functional foods **(Jaime Restrepo-Osorio et al, 2020)**. The health benefits of turmeric included, anti- inflammatory, metabolic syndrome, anti-arthritis and anti-hyperlipidemia, due to its antioxidant effects **(Susan J. Hewlings et al, 2017)**

Table 5: Phytochemicals composition of Turmeric mg/ g

Phytochemicals	**Contents mg/g**
Tannins	1.33
Phenols	0.078
Sterol	0.48
Flavonoid	0.56
Saponins	0.743

Values are means ± standard deviation of three determinations

Table 6: Baseline characteristics of diabetic and bone minerals measure

Data in **table 6** shows baseline characteristics of diabetic and bone minerals measurements as (Ca, P, and K). Twenty participants females aged 45-50 years with height 165±3 Cm, Actual weight 106±1 Kg, perfect weight 75±2 Kg and body mass index 34±5 Kg/m^2. The results indicate an improvement in total cholesterol, triglycerides, HDL, AST, ALT, Urea level, blood glucose level improved to (124 mg/dL) compared to the results before the experience (170 mg/dL), bone minerals level (Ca, P, K) shows improvement (1.13, 4.2 and 4.3) compared to the results before the experience (1.29 mmol/L, 3.05 mg/dl, 3.64 mmol/L). These results agreed with **(Ikpeama et al, 2014)** which mentioned that Turmeric is nutritionally rich in essential vitamins (vitamin B complex) and minerals (Ca, p, K and mg) needed for bone building and body growth. The results were recommended development of new drugs from turmeric. The nutritional and health benefits of curcumin against the chronic diseases as liver and kidney diseases, diabetes, blood pressure and osteoporosis, due to pharmacological effects included, anti-inflammatory, antioxidant, anticancer, cardio-protective, anti-microbial, nephro-protective, anti-neoplastic, hepato-protective, immunomodulatory, hypoglycaemic, anti-rheumatic and decreasing insulin resistance **(Daria Jovičić et al, 2017)**. Also Turmeric acts glucose regulation and augments the effects of diabetes drugs; also, it decreases the insulin resistance which causes type-2 diabetes development **(Rahul Kumar Verma et al, 2018)**. **(Maithili Karpaga Selvi et al, 2015)** investigated the effect of Turmeric as an adjuvant agent against diabetes, there was significant decrease in fasting plasma glucose in turmeric supplemented group, turmeric decreased fasting glucose (95 ± 11.4 mg/dl), also Turmeric exhibited beneficial effects on LDL cholesterol, and increased HDL cholesterol, so Turmeric supplementation is

recommended, due to its effectivenes effects on blood glucose level, oxidative stress and inflammation.

Table 6: Baseline characteristics of diabetic patients and bone minerals measure

Variables	All participants N = 20		
	Measurements before the experiment	Measurements after the experiment	Normal
female	20	_____	_____
Age/ years	45-50	_____	_____
High cm	165±3	_____	_____
Actual weight kg	106±1	90±0.5	_____
perfect weight kg	75±2	85±1.5	_____
Body mass index kg/m^2	34±5	27±1	24 kg/m^2
Total cholesterol mg/dl	207.4±2	176±1.1	200
Triglycerides mg/dl	219.9±1.5	197±1.0	200
HDL mg/dl	37.6±3	49±2.3	55
LDL mg/dl	49.1±3.5	35.7±0.5	_____
VLDL mg/dl	53±3.5	25.5±1.7	_____
AST (IU/l)	16.5±4.1	33.5±0.3	40
ALT (IU/l)	23.6±2.3	38.1±4.1	41
Urea (mg/dl)	25.5±2.1	37.4±1.6	16.6-48.5
Blood glucose level mg/dL	170±2	124±1	120/80
Duration of diabetes years	≤1	_____	_____
Calcium mmol/L	1.29±0.5	1.13±0.6	1.05-1.13
Phosphorus mg/dl	3.05±0.2	4.2±0.2	2.5-4.5
Potassium mmol/L	3.64±0.1	4.3±0.5	3.4-5.1

Conclusion:

Turmeric is a spicy condiment is a flavorful and a colorful. Curcumin is added to butter and margarine to prevent oxidation and improve the color and promote of appetite, Turmeric has received

worldwide attention because of its various health benefits. It acts as a carminative, and treats biliary problems, due to antioxidant and anti-inflammatory properties. According to the results of clinical studies, curcumin may be helpful in the prevention of cardiovascular diseases, diabetes, obesity, inflammatory, and Alzheimer and Parkinson; it should be combine curcumin with agents such as piperine to achieve the best health benefits. . In this paper, supplemented health drinks with turmeric was made and its effects on diabetes and osteoporosis disease were studied, the results showed an improving in the blood glucose level and bone minerals because of its rich in some essential vitamins such as (B1, B2, B3,B6, C and E) and minerals such as (Cu, Mg, Ca, Fe, Zn and K) needed for body growth, so it recommended using the turmeric in right rates to improve flavoring and enhancing fruit preservation processes and the results of the study supports the development of new drugs of turmeric.

The sample of hot and cold drinks


Curcumin coffee


Curcumin tea

Carrot juice with curcumin

Carrot juice control

Lemon juice with curcumin

Lemon juice control


Orange juice with curcumin


Orange juice control

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الملخص العربي:

في هذه الورقة البحثية، تم انتاج مشروبات باردة وساخنة تحتوى على الكركم مثل شاي الكركم ، القهوة اللاتيه وبعض العصائر المدعمة بالكركم مثل عصير الجزر، البرتقال وعصير الليمون كأغذية وظيفية لمرضى السكر وتأثيرها على هشاشة العظام. تم تحضير المشروبات بإضافة ٥ جرام من مسحوق الكركم بدون سكر وتم تقييم الخواص الحسية للمشروبات كالطعم ، اللون، النكهة والملمس، و ذلك بالإستعانة بعدد ٣٠ شخص "مريضة" بالداء السكرى من الإناث المصابات بهشاشة العظام. أظهرت النتائج أن كل المشروبات كانت مقبولة ولا توجد فروق ذات دلالة إحصائية 0.05 >P مقارنة بالمشروبات الضابطة. كما أظهرت النتائج تحسن مستوى سكر الدم ومعادن العظام بعد شهرين ١٢٤ ± ١ مجم/ديسيلتر مقارنة بمستوى سكر الدم قبل الاختبار ١٧٠ مجم/ديسيلتر ، مع تحسن في الوزن ٩٠ ± ٠.٥ مقارنة بما قبل الاختبار ١٠٦ ± ١.٠، تحسن مستوى المعادن بالعظام كالكالسيوم، الفوسفور والبوتاسيوم إلى ١.١٣ ± ٠.٦ مليمول/لتر و٤.٢ ± ٠.٢ مجم/ديسيلتر و٤.٣ ± ٠.٥ مليمول/لتر مقارنة بنفس المعادن قبل الإختبار ١.٢٩ مليمول/لتر و٣.٠٥ مجم/ديسيلتر و٣.٦٤ مليمول/لتر. **الخلاصة:** يوصى بمزج الكركم بنسب مناسبة في مشروبات الفاكهة " العصائر" والمشروبات الساخنة كمنكهه، أو مادة حافظة أو بديل للعلاج.