

## Original Article

# Expediton of Nutraceutical Potential of Crucumin and Piperine to Formulate Functional Food Product

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## ABSTRACT

**Background and Objective:** Turmeric and black pepper provide effective treatment for various heart diseases such as hyperlipidemia and hypertension. Alkaloid piperine present in black pepper increases the efficiency and bioavailability of curcumin present in turmeric upto 2000%. The purpose of this study was to produce a novel, beneficial and consumer acceptable product Turmeric and black pepper cookies as a functional food to utilize its nutritional potential and increase the bioavailability of essential nutrient in the body.

**Methodology:** The preparation of cookies will involve four different treatments T<sub>0</sub> as control T<sub>1</sub> (4 g turmeric + 40 mg black pepper powder), T<sub>2</sub> (6 g turmeric + 60 mg black pepper powder) and T<sub>3</sub> (8 g turmeric + 80 mg black pepper powder) addition of oatmeal porridge powder and honey to make the product acceptable for population. And then cookies were checked for sensory evaluation. Proximate analysis of turmeric and black pepper powder were examined to evaluate the nutritional values and the obtained data was also analyzed statistically to check the level of significance among different attributes.

**Results:** The results of the Sensory evaluation revealed that T<sub>3</sub> attained highest rating and were selected as most acceptable treatment. Most palatable quantity of turmeric and black pepper unveiled was 8 g and 80 mg respectively, when incorporated in single serving of cereals to give immense amount of functional food to improve hypertension and lipid profile of an individual and the results among all sensory attributes is highly significant.

**Conclusion:** Hence the study concludes that Black pepper and turmeric cookies improves hypertension and lipid profile of an individual. However it is not preferred for consumption in fresh form because of its bitter and pungent taste, Therefore its use can be enhanced in form of turmeric and black pepper cookies.

## INTRODUCTION

Globally, Hyperlipidemia is most prevalent disease and a major contributor to cardiovascular complication. CVD's is a major cause of death in the world and a major impediment for continual human development<sup>1</sup>. Death rate around the globe from cardiovascular diseases has increased from 14.4 million in 1990 to 18.9 million in 2017 and is continuously increasing in all high income and some middle-income countries<sup>2</sup>.

Cardiovascular diseases are still the major reason behind the mortality rate of females and from a recent statistics disclosed by US statistics, 398,083 female deaths were reported in 2013 due to CVD. Cardiovascular diseases related information has been slowly progressing as in 1997 only 30% of women of America were know about CVD

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and it was the major reason behind the higher death rates of women this percentage has been increased to 54% in 2009<sup>3</sup>.

Many herbs are used as a replacement to treat many medical issues like hypertension, CVD's, and hyperlipidemia. In many countries, turmeric is used form centuries and plays a significant role in traditional Chinese and Ayurvedic medicines. Previously, it was used as dye, and later on, it was considered as human medicine when the researches show its medical properties<sup>4</sup>.

Curcumin is apolyphenol present in turmeric, with marked set of huge health benefits. The significant properties of curcumin includes improved regulation of oxidation, inflammation, blood fat level, blood sugar level, cell signaling and brain levels of omega-3 fatty acids called DHA.

A part from other properties of curcumin, it also restrict the proliferative activity of smooth muscle growth in vitro and initiate apoptosis, in this, way it plays a role in preventing pathological changes in the vessels of blood<sup>5</sup>.

Many findings shows that curcumin have anti-tumor, anti-inflammatory as well as anti-oxidant properties<sup>6</sup>.

The family of Piperceae has a flowering vine names as Piper nigrum, which is harvested as fruit and is than dried which can be than used as seasoning and spice. Piperine is responsible for the sharpness of Piper nigrum and Piper longum that are the sources of long black pepper<sup>7</sup>.

Dietary piperine can initiate the digestive enzymes present in pancreas. It also enhances the capability of digestion along with reducing the gastrointestinal time of food transmission. It has been shown in many vitro studies that piperine is a spice, which protects from oxidative damage by restricting the activity of oxygen species and free radicals. Black pepper is also used is in curative measures in decreasing lipid per-oxidation in vivo and effect cellular thiol in good manner<sup>8</sup>.

In addition to previously mentioned studies, other studies that was carried out on animals and human beings depicts that curcumin have the capability of lowering the total cholesterol level in the blood<sup>9</sup>. Until now, it is not declared that curcumin act as a therapeutic agent against hyperlipidemia, which is due to its bioavailability<sup>10</sup>. but the presence of piperine in black pepper can enhance the bioavailability of turmeric upto 2000% within 45 min. after consuming mixture of curcumin and piperine orally<sup>11</sup>.

If piperine is consumed with curcumin, it can than has the capacity to affect the metabolism of various substances. Black pepper increases the bioavailability of curcumin by the inhibition of intestinal and liver glucuronidiation. As an example, piperine increases the efficiency of curcumin by increasing the effect of curcumin contrary to unpredicted chronic stress-induces mental and depressive disorders<sup>12</sup>.The anti-hypertensive effect of piperine on blood pressure has been shown after administrating it intravenously or in high doses if taken orally (50 mg kg<sup>-1</sup>)<sup>13</sup>.

### **Objectives:**

- To determine the nutritional profile of turmeric and black pepper
- To develop turmeric and black pepper cookies
- To get sensory evaluation of cookies

## **MATERIAL AND METHODS**

The current research was carried out in The University of Faisalabad. The research study was conducted to determine the nutritional profile of turmeric and black pepper to formulate an innovative food product. Turmeric and Black pepper were brought from

the local market of the Faisalabad. Turmeric and Black pepper were methodologically examined for proximate and mineral analysis, Fruther more the turmeric and black pepper were processed separately to formulate functional food product; cookies. In this unit, the methodology followed is discussed in detail

**Proximate analysis:** Turmeric and black pepper were analytically processed to determine their moisture, ash, crude fat, crude protein, crude fiber and nitrogen free extract according to the protocols cited in AOAC (2006) respectively. The brief explanation for each analytical procedure is discussed

**Moisture content:** The technique is used according to the protocols of AOAC (2006). The samples were weighed and in the Air Forced Draft Oven at a set temprature 105 ± 5°C till the weight is constant.

$$\text{Moisture (\%)} = \frac{\text{wt. of fresh sample (g)} - \text{wt. of dried sample (g)}}{\text{wt. of fresh sample (g)}} \times 100$$

**Crude protein** The crude protein percentage value was calculated by application of Kjeldahl’s method following the guidelines of AOAC (2006).

$$\text{N (\%)} = \frac{\text{Vol. of 0.1 normal H}_2\text{SO}_4 \times \text{Vol. of dillution (250 mL)} \times 0.0014}{\text{Volume of Distillate taken} \times \text{wt. of sample (g)}} \times 100$$

**Crude fat** Crude fat was determined by taking 3 g of each sample in the Soxhlet’s Apparatus by using ethanol as a solvent

$$\text{Crude fat (\%)} = \frac{\text{wt. of sample (g)} - \text{wt. of fat free sample (g)}}{\text{wt. of sample (g)}} \times 100$$

**Crude fiber** The crude fiber was considered as the loss in weight during the process of ignition as mentioned in the guidelines in AOAC (1990).

$$\text{Crude fiber (\%)} = \frac{\text{wt. of dry residue (g)} - \text{wt. of ash (g)}}{\text{wt. of sample}} \times 100$$

**Ash content:** The total ash content was assessed by the method of direct incineration following the respective protocols of AOAC (2006).

$$\text{Ash content (\%)} = \frac{\text{wt. of ash (g)}}{\text{wt. of sample (g)}} \times 100$$

**Nitrogen Free Extract (NFE):** The NFE of the turmeric and black pepper sample were determined according to expression mentioned below;

$$\text{NFE (\%)} = 100 - (\text{Crude Protein} + \text{Crude Fat} + \text{Crude Fiber} + \text{Ash})\%$$

**Statistical analysis** The data was designed by employing ISD on proximate analysis and ANOVA was applied on sensory evaluation to get the mean values of all sensory parameters by appling the outlined principles and methodology by Robert.<sup>14</sup>

**Product development:** Cookies were prepared from the powder of turmeric and blackpepper. The preperation of cookies involved four treatments (T) T<sub>0</sub> as control, T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> worked as a cookies with turmeric and black pepper with different measured concentration as shown in Table 1

**Table 1:** Treatments used for turmeric and black pepper cookies formulation

Treatments	Description	Quantity of sample (g)
T <sub>0</sub>	Control (cookies without any treatment)	0
T <sub>1</sub>	Turmeric + black pepper cookies	4 g turmeric+ 40 mg black pepper
T <sub>2</sub>	Turmeric + black pepper cookies	6 g turmeric+ 60 mg black pepper
T <sub>3</sub>	Turmeric + black pepper cookies	8 g turmeric+ 80 mg black pepper

**Table 2:** Turmeric and black pepper cookies recipe

Ingredients	Quantity
Whole wheat flour + Oats porridge powder	½ cup+ ½ cup
Turmeric and black pepper powder	48 g turmeric and 720 mg of black pepper
Honey	1 tbspoon
Butter	4 tbspoon
Baking powder	½ tspoon

**Preperation of powdered Turmeric and Black pepper:** Both the turmeric and blackpepper were freshly grounded to make fine powder, Afterwards, used in the production of cookies accordingly.

**Cookies preparation:** Cookies of variable treatments as mentioned in the (Table 1) were prepared by following the recipe stated in Table 2

The ingredients were weighed with accuracy and all the contents were mixed throughly untill uniform mass was obtained. The mass was kept for 30 min. in polythene bag. The dough was seperated into four parts, cut the cookies with cutter and make 1 set of four cookies with out any turmeric and black pepper(control cookies) and then make sets of 3 cookies containing 4 cookies (each cookie weighed 25 g). Preheat the oven on 200°C for 15 min. Bake cookies on 180°C for 15 min. and leave them in air for half an hour then stored accordingly.

Sensory Evaluation: Sensory evaluation of cookies( $T_0, T_1, T_2, T_3$ ) was performed by a trained panel for taste, 9 point hedonic scale was employed by a considering the guidelines provided by Meilgaard<sup>15</sup> given in Appendix – I. Moreover, all the quality characteristics of cookies like taste, color, texture, aroma, and overall acceptability according to their sensory responses were recorded. The evaluation process was conducted in booths separate for each panelist under clear white light in the Nutrition and Sensory Evaluation laboratory of The University of Faisalabad. The panelists were served the sample in plates accordingly with random codes on the day of evaluation. The panelists were utterly explained about the nature and essence of the experiment. During the process of evaluation the panelists were also served mineral water to neutralize the after taste and to rinse for rationalized assessment. The panelists were requested and guided to give the product quality a rating by scoring for the parameters chosen for them.

## RESULTS AND DISCUSSION

The current research was conducted to evaluate the nutritional profile of curcumin and black pepper powder. For the research plan, the turmeric and black pepper powder sample was bought from the local market of the Faisalabad. The sanitary and hygienic standards were conserved to keep their quality safe. The samples were passed from chemical analytical methods. The study plan was splitted in different stages, such as, digestion mixture preparations for mineral and protein analysis, innovation of food product; turmeric and black pepper cookies for the evaluation of their sensory characteristics.

**Proximate analysis** The proximate analysis is a set of different procedures that are used to get athuentic knowledge regarding the nutritional profile of food product. They were developed around 1850 particularly for animal feed. These analyses use certain physical-chemical properties of a particular group of nutrients in their procedures.

The analysis performed in this research plan were dry matter by drying at 103°C; total ash was evaluated by incineration at 550°C, crude protein was analyzed by kjeldhal

determination of nitrogen, crude fibre was determined as the organic fraction remaining after acid-alkaline hydrolysis and crude fat as the fraction extracted by using petroleum ether. Nitrogen free extract was also evaluated by using proximate analysis of carbohydrates fraction in Table 3.

ensory evaluation of turmeric and black pepper cookies: The conduct of sensory evaluation of turmeric and black pepper cookies, a main step of the research project were taken out at room temperature under bright white shaded light. The freshly made cookies were placed on clean white disposable plates, and covered with transparent sheets, and were marked accordingly. Napkins, utensils, and water for rinsing were given to the judges. The cookies were served to the judges in a sequence and were asked to mark them for all the provided parameters. Their evaluation according to 9-point hedonic scale. The sensory attributes that were evaluated were; appearance, color, aroma, texture, moisture, taste, mouth feel, chewiness and overall acceptability.

The mean values displayed in the table clear the effects of treatments on sensory parameters of the cookies. The statistical results showed that variable treatments have highly significant effect on all sensory parameters of turmeric and black pepper cookies. In the treatments, T<sub>0</sub>, was displayed as control group with no amount of turmeric and black pepper added in the cookies. 4 gm of turmeric with 40 mg black pepper were added in T<sub>1</sub>, 6 gm and 60 mg of turmeric and black pepper respectively were added in T<sub>2</sub> and 8 gm of turmeric along with 80 mg black pepper were added in T<sub>3</sub>. The results of the different treatments are described below in Table 4.

**Table 3:** Mean values for proximate analysis (%)

Parameters (%)	Turmeric	Black pepper
Moisture	9.02±0.03 <sup>c</sup>	5.65±0.03 <sup>b</sup>
Total Ash	2.65±0.02 <sup>c</sup>	4.35±0.01 <sup>b</sup>
Crude protein	9.27±0.03 <sup>b</sup>	11.70±0.03 <sup>a</sup>
Crude Fat	6.85±0.01 <sup>b</sup>	12.70±0.04 <sup>a</sup>
Crude Fiber	4.57±0.02 <sup>a</sup>	2.51±0.02 <sup>c</sup>
NFE	66.95±0.02 <sup>a</sup>	62.84±0.02 <sup>b</sup>

**Table 4:** Mean value for different treatments

Characteristics	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Appearance	7.8±0.3 <sup>a</sup>	6.8±0.7 <sup>b</sup>	6.8±0.5 <sup>b</sup>	4.3±0.3 <sup>c</sup>
Color	7.5±1.0 <sup>b</sup>	6.8±0.5 <sup>c</sup>	4.0±0.5 <sup>d</sup>	8.0±0.3 <sup>a</sup>
Aroma	7.00±.05 <sup>b</sup>	6.5±0.9 <sup>c</sup>	4.0±.00 <sup>d</sup>	8.0±0.9 <sup>a</sup>
Texture	5.5±.04 <sup>c</sup>	6.3±0.2 <sup>b</sup>	4.3±0.5 <sup>d</sup>	8.0±0.9 <sup>a</sup>
Moisture	5.6±1.0 <sup>c</sup>	5.75±0.2 <sup>b</sup>	5.0±0.5 <sup>d</sup>	8.0±0.4 <sup>a</sup>
Taste	7.0±0.7 <sup>b</sup>	6.0±1.0 <sup>c</sup>	4.8±0.4 <sup>d</sup>	8.0±0.5 <sup>a</sup>
Mouth feel	7.0±0.4 <sup>b</sup>	6.5±0.9 <sup>c</sup>	3.8±00 <sup>d</sup>	8.3±0.5 <sup>a</sup>
Chewniess	5.0±1.3 <sup>c</sup>	6.5±1.2 <sup>b</sup>	3.8±00 <sup>d</sup>	7.8±00 <sup>a</sup>
Over all acceptance	6.5±0.3 <sup>b</sup>	5.0±0.8 <sup>c</sup>	4.0±0.3 <sup>d</sup>	8.3±0.5 <sup>a</sup>

T<sub>0</sub> = Control group

T<sub>1</sub> = Cookies with turmeric and black pepper (4 g+40 mg)

T<sub>2</sub> = Cookies with turmeric and black pepper (6 g+60 mg)

T<sub>3</sub> = Cookies with turmeric and black pepper (8 g+80 mg)

Appearance of turmeric and black pepper cookies: Mean values of the appearance showed highly significant results of turmeric and black pepper cookies among different treatments. The highest value was achieved by T<sub>0</sub> group (7.8±0.3), while the lowest was achieved by T<sub>3</sub> group (4.3±0.3). T<sub>1</sub> and T<sub>2</sub> showed comparable results (6.8±0.7; 6.8±0.5) respectively as shown in Table 5.

**Color of turmeric and black pepper cookies** Among all 4-treatment groups as described in Table 6 T<sub>3</sub> attain the highest scorer (8.0±0.3). T<sub>0</sub> was the second achiever, (7.5±1.0) which was the control group. T<sub>1</sub> was on the third level (6.8±0.5) and T<sub>2</sub> was the lowest scorer among all the treatments (4.0±0.5).

**Aroma of turmeric and black pepper cookies:** The lowest scorer among all the treatments was T<sub>2</sub> (4±0.0), T<sub>1</sub> was on the third number in the mean table of aroma (6.5±0.9). Control group cookies were on second place (7±0.5). T<sub>3</sub> was the highest achiever among all the treatments (8±0.9) as shown in Table 7

**Texture of turmeric and black pepper cookies:** Among texture mean values, T<sub>3</sub> was ranked higher (8±0.9) in comparison with other products. T<sub>1</sub> and T<sub>0</sub> were ranked second and third in the mean value table (6.3±0.2 and 5.5±0.4) respectively. T<sub>2</sub> was not much liked by the judges and was scored the lowest among all treatments (4.3±0.5) as shown in Table 8

**Table 5:** Analysis of variance for the appearance of turmeric and black pepper cookies

Source	df	SS	MS	F	P
Treatment	3	42.6875	14.2292	11.6	0.0007
Error	12	14.7500	1.2292		
Total	15	57.475			

\*\*P is 0.0007 that is highly significant

**Table 6:** Analysis of variance for the color of turmeric and black pepper cookies

Source	df	SS	MS	F	P
Treatment	3	37.6875	12.5625	6.35	0.0080
Error	12	23.7500	1.9792		
Total	15	61.4375			

\*\*P0.0080 that is highly significant

**Table 7:** Analysis of variance for the color of turmeric and black pepper cookies

Source	df	SS	MS	F	P
Treatment	3	29.5000	9.83333	7.61	0.0041
Error	12	15.5000	1.29167		
Total	15	45.0000			

\*\*P0.0041 that is highly significant

**Table 8:** Analysis of variance for the texture of turmeric and black pepper cookies

Source	df	SS	MS	F	P
Treatment	3	55.6875	18.5625	10.0	0.0041
Error	12	22.2500	1.8542		
Total	15	77.9375			

\*\*P0.0041 highly significant

**Table 9:** Analysis of variance for the moisture of turmeric and black pepper cookies

Source	df	SS	MS	F	P
Treatment	3	64.5000	21.5000	9.38	0.0018
Error	12	27.5000	2.2917		
Total	15	92.0000			

\*\*P0.0018highly significant

**Table 10:** Analysis of variance for the taste of turmeric and black pepper cookies

Source	df	SS	MS	F	P
Treatment	3	45.1875	15.0625	7.16	0.0052
Error	12	25.2500	2.1042		
Total	15	70.4375			

\*\*P0.0052highly significant

**Table 11:** Analysis of variance for the mouth feel of turmeric and black pepper cookies

Source	df	SS	MS	F	P
Treatment	3	45.1875	15.0625	10.8	0.0010
Error	12	16.7500	1.3958		
Total	15	61.9375			

\*\*P0.0010highly significant

**Table 12:** Analysis of variance for the chewiness of turmeric and black pepper cookies

Source	df	SS	MS	F	P
Treatment	3	58.2500	19.4167	8.47	0.0027
Error	12	27.5000	2.2917		
Total	15	85.7500			

\*\*P0.0027highly significant

**Moisture of turmeric and black pepper cookies** The mean value cell of moisture content among different treatments showed that T<sub>3</sub> group has the higher moisture content in it (8±0.4). Meanwhile, T<sub>1</sub> and T<sub>0</sub> were on the second and third place on the table, (5.75±0.2 and 5.6±1.0) respectively. Yet, T<sub>2</sub> was on the last place with the mean value (5±0.5) as shown in Table 9

**Taste of turmeric and black pepper cookies** On the mean value table of taste, T<sub>3</sub> was marked as more tasty as compared to other treatments, (8±0.5), whereas, T<sub>2</sub> was the lowest graded treatment, (5±0.5). T<sub>0</sub> was on second place with mean (7±0.7) and T<sub>1</sub> was on third place with mean values (6±1.0) as shown in Table 10

**Mouth feel of turmeric and black pepper cookies:** The mean value table of mouth feel depicted that T<sub>2</sub> has the lowest acceptability among other treatments (3.8±0.0). Control group was ranked 2<sup>nd</sup> by the panelists with mean (7.0±0.4), T<sub>1</sub> was on 3<sup>rd</sup> position with mean (6.5±0.9). Among all the treatments, T<sub>3</sub> was highly accepted by the judges, as the mean of it was (8.3±0.5) as shown in Table 11

**Chewiness of turmeric and black pepper cookies:** On the mean table of chewiness, T<sub>3</sub> treatment was on the 1<sup>st</sup> place with mean (7.8±0.0), T<sub>2</sub> was lowest on the mean table, (3.8±0.0). T<sub>1</sub> was on 2<sup>nd</sup> place among all treatments (6.5±1.2) and T<sub>0</sub> was on third place with mean (5±1.3) as shown in Table 12

**Table 13:** Analysis of variance for the overall acceptability of turmeric and black pepper cookies

Source	df	SS	MS	F	P
Treatment	3	42.7500	14.2500	8.14	0.0032
Error	12	21.0000	1.7500		
Total	15	63.7500			

\*\*P0.0032 highly significant

**Overall acceptability of turmeric and black pepper cookies:** The mean value table depicted that T<sub>3</sub> has the highest overall acceptance with the mean (8.0±0.5), on the 3<sup>rd</sup> place, T<sub>1</sub> was present, with the mean (5.0±0.8). T<sub>0</sub>, which was the control group, occupied 2<sup>nd</sup> place in the mean value table with mean (6.5±0.3). T<sub>2</sub> was ranked lowest among all with less acceptability from panelists, with mean (4.0±0.3) as shown in Table 13

Hefnawy along with its coworkers in 2016, conducted a research with goal to investigate the anti-oxidant potential of carrots, turmeric and grape leaf powder which was extracted. The biscuits were made in order to evaluate the addition of natural anti-oxidants in them. Chemical along with physical characteristics were carried out during processing and storage.<sup>18</sup>

Another study conducted by Bheema along with his co-workers in 2008, explore the use of natural antioxidants from plant sources such as in turmeric and curcumin, in biscuit making, their physical and chemical characteristics while processing and storing were evaluated in order to understand the presence of natural anti-oxidants in biscuits<sup>19</sup>.

SH Park in 2012 with his co-workers made anti-oxidant rich cake by adding turmeric powder, in order to assess the good physico-chemical and sensorial properties<sup>20</sup>.

By taking these researches as base references, the present study was conducted in which turmeric and black pepper cookies with their different constituents were innovated for hypertensive and patients suffering from CVD's and their sensory parameters were assess by trained panelists.

## CONCLUSION

The cookies were developed with various concentrations of turmeric and black pepper powder depicted that T<sub>3</sub> group cookies (8 gm of turmeric and 80 mg of black pepper powder) scored highest among all sensory parameters. It is recommended that consumption of two servings of these cookies can provide substantial amount of functional food; turmeric and black pepper powder. The comparative analysis of turmeric and black pepper powder depicted that their powder is richly packed in nutrients such as CHO, proteins, fat, fiber, moisture and ash content.

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