Assessment of antioxidant potential, nutritional and functional profile of turmeric.

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Abstract: Turmeric and its bioactive compounds like curcumin had great therapeutic abilities against many diseases. In this study turmeric and its extract was evaluated for its hypoglycemic potential in streptozotocin induced hyperglycemic rats for thirty days. For this purpose turmeric powder was assessed for proximate analysis and the values for proximate was as follow Amount of Moisture was 11.80±1.06 while the content of Crude protein was 4.705±.75, Crude fat content was 3.3±.2, Crude fiber was 5.7±.12, Ash content 3.96±.10 while nitrogen free extract was 71.92±1.58 then mineral quantification was done and the mineral content was as follow Calcium as 204.86 ± 1.82mg/100g, Potassium (K) was 289.18 ±7.19 while content of sodium was 25 ±0.59 and Iron (Fe) content was 8.43±0.40 and then extract obtained was analyzed for its antioxidant potential via screening tests like DPPH, TPC and FRAP. The best result for TPC was seen with concentration of 70% of ethanolic extract gives the best result for TPC and its total phenolic content was 536.56 ± 2.24 mg GAE/100mg followed by methanolic extract at the concentration of 70% gives the TPC value 529.62 ±6.56 GAE/100mg and from acetone the best extraction percentage was also 70 % and its TPC value was 524.94 ± 1.54. The maximum DPPH value was seen with ethanolic extract at concentration of 70% 59.58 ±2.89.

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1. Introduction

Phytochemicals coupled with dietary modifications gained a lot of importance because of their effect on the health of humans and in result it reduces the risk of life threatening disorders. The active ingredient present in the food is responsible for its disease preventive ability. This thing encouraged the community health practitioners to increase the therapeutic capacity of commercially prepared food (Bech-Larsen & scholderer, 2007; Kim *et al*., 2011). Phytochemicals are covering more than 8000 different varieties according to structure; these are basically not the nutritive parts of plants. The daily base consumption of these bioactive ingredients decreases the incidence of many diseases because of its high oxygen scavenging ability (Manach *et al*., 2004). Dietary pattern based on these phytonutrients decreased the medical expenses by promoting health in this way it has financial benefit for the state (Epstein *et al*., 2010). Due to various side effects of conventional medicines people are moving towards natural methods of treatment. That is why nutraceutics have gained so much fame around the world due to their health promoting potential. (EL-Sohaimy, 2012; Epsin *et al*., 2007). Bioactive compounds presence in spices has been proved and their presence in food work as natural protective compounds (Srinivasan, 2005). One of the most importantly used spices is turmeric, used as additional culinary product, as a drug, dye and in beauty products. Turmeric is one of the most commonly used plants in many countries especially in Asia (Lal, 2012).

Its rhizome used as spice for flavoring and coloring of the foods. It is basically an evergreen tree having leaves which are very large, a stem which is very small and its rhizomes are yellowish in color. Any type of harm that is caused by inflammation turmeric is used to cure that ailment. It is used for the treatment of swelling caused due to injury. Turmeric belongs to class Liliopsdia, family Zingiberacaeae, Genus Curcuma while species curcuma longa. Its powder is used for the cure of cough, anorexia, liver disorders, abdominal disorders and diabetic wounds. Pakistan is second biggest grower of turmeric, although production quantity per acre is very low. Turmeric composed of 5.1% fat, 13.1% moisture, 3.5 % minerals, 69.4% carbohydrates and 6.3% protein. Potassium, Phosphorus iron and sodium quantity in turmeric is about.031, 71.035 &.009 mg respectively. The amount of copper in in 100g of turmeric is about in a range of 0.001 to 0.003 mg/100kg. It contains a filthy amount about 91 mg of fat soluble vitamin named as vitamin A. It has cure for inflammation, fungal infection, mutagenesis, carcinogenesis, hepatotoxicity, sterility, fibrosis, cholesterol, diabetes, ulcer, hypertension, viral diseases and coagulation

problem. Now days it is used against Alzheimer's, Rheumatoid arthritis, bowel disease, Multiple sclerosis, HIV and Cataract (Jeevangi, 2013). Essential oils and curcuminoids are important bioactive compounds of Turmeric. 3-4 % of turmeric rhizome contains curcuminoids. While Curcumin I accounts for 94%, curcumin II accounts for 6 and III accounts for 0.3% (Chattopadhyay *et al*., 2004). Curcumin is physically a crystalline orange yellowish powder which is water insoluble. Remaining bioactive compounds includes which have lower oxygen scavenging potential including beta sitosterol, beta carotene, p-coumaric acid, terpinene, turmerin, camphene, turmeronola, vanillic acid, turmeronol-b, campsterol and syringic acid (Naz *et al*., 2010). A safe, tolerable and non-poisonous dose of curcumin has been seen 12 g/day. FDA declared Turmeric and its active compounds as generally regarded as safe (Kumar *et al*., 2011).

The average intake of turmeric varies from 0.5 to 1.5g/day/person. Intake of junk food and bad dietary habits globally increase the production of free radicles and many other diseases which are dangerous for life. Economical and safe food based policies are the main concern of public health practitioners. A healthy life is always linked with good dietary recommendations, novel nutritional practices and good living patterns (Kumar *et al*, 2009). Foods which are designed have innate ability to augment from diseases and they look same alike commercially available foods. These products use on daily bases due to their linked health benefits. Intake of these designed foods has a greater trend in modern countries (Manjula and Suneetha, 2011).

Firstly, the advices made for healthy life style to use fewer amounts of fats and take a lot of vegetables and fruits which are rich in antioxidants. For better bodily performance food is always a feasible way (Ismail, 2006). That is the reason nutrition therapy due to its disease managing ability gain a lot of importance. These days commercially prepared special foods available which have ability to scavenge free radicles, cholesterol lowering and glucose lowering ability (Gorinstein *et al*., 2006). Foods which are from plant origin contain different phytochemicals that has free radicles scavenging ability. Herbs and spices have functional compounds like vitamins, essential oils, antioxidants, minerals and fiber. For better antioxidant potential profile there is a need to concentrate these compounds (Tapsell *et al*., 2006). Turmeric composed of 3.5% minerals, 5.1% fat, 6.3% protein, 69.4% carbohydrates and 13.1% moisture, while the oil of turmeric contains almost 53 percent of Sesquiterrpines, 25% of zingiberene, 1% of cineol, 0.5% of borneol and 1% of phellandrene. It is also a fair source of fat soluble vitamin Retinol which is about 91mg and 100 g of its providing 310 kcal (Chattopadhyay *et al*., 2004). The daily intake which consider safe by the World health organization is about 2.5mg/kg.B.W (Sarkaki *et al*., 2013). Curcumin 71.5%, bisdemethoxycurcumin 9.1% and desmethoxycurcumin 19.4% are basically the non-evaporative fraction of turmeric. The chemical formula of Curcumin which is the basic compound of turmeric is $C_{21}H_{20}O_5$ having molecular weight 368.38g (Anand *et al*., 2007). In societies technological populace use of pure oxidation preventing compounds from natural food sources from plants are increasing. It has been explained from different researches that regular use of pure oxidation preventive compounds in routine menus helps in prevention from the dysfunctions which are related to our way of living. But, the production of O_2 reacting compounds is a natural process, if balance between free radicals and antioxidants is destroyed; it will destroy the integrity of biological molecules (Lim and Han, 2016). Polyphenols are the main plant species present in plant foods such as fruits and vegetables, grains and spices. In addition, there is strong evidence to support the presence of botanicals in spices and their positive health effects (Srinivasan, 2005). In addition to being a culinary ingredient. Basically, spices are seasoned with aromatic properties and are usually incorporated into traditional cooking (Kunwar *et al*., 2011). Among them, turmeric is widely used as a spice, cooking additives, medicine, spices, dyes and cosmetics, one of the important herbs (Lal, 2012) The active ingredients in these foods are associated with health promoters and disease prophylaxis (Suleria *et al*., 2015). In this case, the fragrance is worth considering its antioxidant potential and is confirmed by various efficacy studies, particularly cinnamon, turmeric, clove and fennel (Kochhar, 2008). In order to evaluate the antioxidant index of curcumin, various plant extracts were extracted using various organic solvents. Two processes are used on the basis of their method of doing something, first is linked control the free electron and the second is rely on the peroxidation of lipids. The second one consist of ABTS, ferrous reducing antioxidant power, DPPH, and ferrous ion chelate (Suleria *et al*., 2012). Phytoremediation based on turmeric bioactive substances tends to improve the health of individuals by scavenging free radicals. The chemistry based investigation showed that α, β-unsaturated carbonyls of turmeric phenolic compound e.g. curcumin were indulge in nucleophiles balance. Since curcumin exhibits a structure which is di-ketonic, it is an interdependent b/w ketone & enol forms, these have a greater oxidation preventing capability (Kelkel *et al*., 2010). The oxidation against function of bioactive compound of turmeric 'curcumin' is appreciated due to it's to its functionally

active proportion; the betadiketone is taking the responsibility for the movement of free electrons. Or they interact with ROS or advance the gesture to a lot of targeting compounds Aggarwal and Sung (2009). About 75 to 80 % of total curcuminoids present in the turmeric is composed of curcumin. Curcumin has the ability to lessen the formation of H2O2, Nitrile radicles and superoxide in this way it stops the damage to erythrocytes. Free radicles scavenging ability of turmeric is hundred times more than tocopherols and ascorbic acid. It breaks the bond in conjugated structures of methoxylated phenolic and β-diketone groups by scavenging the free radicles. Different varieties of turmeric contain different amount of curcumin depending upon the growing conditions etc. Curcumin has antioxidant potential in two different ways: firstly its ability depends upon the free radicle scavenging power and second depends upon the lipid peroxidation (Moon and Shibamoto, 2009). The antioxidant ability of curcumin which is assessed by iron chelation assay and DPPH markedly decreased by drought conditions. The bioactive compound of turmeric named as curcumin is very sensitive to high temperatures which results in deterioration and evaporation which results in the loss of curcumin (Cousins et al., 2007). Polyphenols potential of reduction against free radicles can be better quantified by DPPH & ABTS methods.

2. Material and method

2.1. Procurement of raw material

The randomized controlled trail will be conducted in Fruits and Vegetables Processing laboratory, National Institute of Food science and Technology, Faculty of Food, Nutrition and home sciences, University of Agriculture Faisalabad. For analysis Turmeric powder will be purchased from local market.

2.2. Preparation of sample

The rhizome of turmeric firstly washed and after washing kept it into the hot air cabinet dryer for drying at the temperature of 60^{o}C for duration of 8 to 10 hours. Then by the help of grinder this dried rhizome of turmeric grounded to obtain a fine powder of turmeric. This turmeric powder for further analysis was stored at normal temperature.

2.3 Characterization of Turmeric powder

2.3.1. Proximate Analysis

The turmeric powder will be analyzed for moisture, ash, crude fat, crude protein, Nitrogen free extract and crude fiber by following their respective methods of AOAC (2006).

2.3.2. Mineral Analysis

Minerals like Na and K will be determined through Flame photometry, Ca and Fe will be determined through Atomic Absorption spectrophotometer according to the procedures of AOAC (2006).

2.3.3 Preparation of turmeric extract

Turmeric extracts will be prepared by using three solvents; methanol, ethanol and acetone following the protocol of Bagchi *et al.* (2012).

T1	Methanol	50%
T2		70%
T3		90%
T4	Ethanol	50%
T5		70%
T6		90%
T7	Acetone	50%
T8		70%
T9		90%

2.4 Extract Analysis:

2.4.1. Total Phenolic Content:

TPC in Turmeric extract will be measured using Folin-Ciocalteu method as mentioned by Himesh *et al*. (2003).

2.4.2. Total Flavonoid Content (TFC)

Total flavonoid content will be determined using a modified calorimeter assay following the method of Kim *et al*. (2003).

2.4.3. Quantification of Curcumin:

Curcumin will be quantified using HPLC-UV following the protocol of Wichitnithad *et al*. (2009).

2.5 Antioxidant Potential

2.5.1. Free radical scavenging ability (DPPH assay)

The extract was analyzed for free radicle scavenging activity following the protocol of (Kumar *et al*., 2006). DPPH is a stable free radical, which exhibits a dark purple, with a characteristic absorption band of 517 nm. The odd electrons of this oxidizing group are paired in the presence of free hydrogen atoms of the phenolic antioxidant, resulting in reduction and stabilization to form yellow hydrazine (DPPH-H), thereby reducing the absorption intensity. Free radical scavenging activity depends on the amount and nature of the polyphenol content. In this paper, 3 mL of the freshly prepared DPPH solution was mixed with 77 uL of the sample extract in the respective solvent (6 x 10^{-5} M), and each extract and blank (containing the same amount of solvent and other than the extract DPPH solution) was kept in the dark for about 15 minutes, the absorbance reduction in the 517 nm test extract was measured using an ultraviolet / visible spectrophotometer. The absorbance of the blank sample was 517 nm, the percentage of DPPH radical inhibition was determined by the UV / Visible spectrophotometer Calculated as follows:

Reduction of absorbance (%) = [absorbance of blank sample at t = 0 min AA - absorbance of the tested extract at t = 15 min) / absorbance of blank sample at t = 0 min AA] × 100

2.5.2. Ferric reducing antioxidant power (FRAP assay)

According to Asimi *et al*., (2013) the guidelines analyze the iron reduction capabilities of the extract. This guideline depends on the reduction of the iron tripyridine triazine complex into its iron framework within the field of view of the cancer prophylactic agent. The blue arrangement constitutes the absorbance (An) of the response mixture, showing a solid decreasing power. According to this protocol, 5 mL I was added to 40 mmol / L HCL by including a 50 mL acetic acid-derived cradle, 5 mL TPTZ (2,4,6-dipyridyl-S-triazine). ECl 3 · 6H 2 O (20 mmol / L fluid arrangement). At this time, 50 uL turmeric isolate was mixed with 950 µL of FRAP reagent for 4 minutes. The absorbance of the blue color was then measured by 593 nm spectrophotometry. Was adjusted using a water arrangement of FeSO 4 · 7H 2 O (100-1000 uM) as a micromolar Fe (II) / g

2.6 Statistical Analysis

The resultant data will be subjected to statistical analysis to determine the significance as described by Montgomery (2008).

3. Result and discussion

For the cure of many diseases, a nutrient which contains bioactive compounds attaining a lot of importance. Spices are the real source of these phytochemical compounds. Real research which is related to the health benefits of turmeric is not available in Pakistan. The main purpose of this study is to find out the beneficial effect of turmeric for the cure of different diseases especially liver and kidney diseases. First of all nutrient composition of turmeric was assessed followed by the conventional extraction of turmeric by different fluids. Then the best extraction solvent was selected and given to the rats and then evaluated the effect of these extracts on rats. After that the results were statistically interpreted to check the significance of study.

3.1. Turmeric characterization

To assess the quality attributes of the desired component, raw material's characterization is very effective tool. The research material initially was prepared to check the proximate test which included Nitrogen free extract (NFE), crude fiber, crude protein, moisture and crude fat. While the analysis of minerals and oxidation preventive test were discussed in later section which is related to nutritional components of the curcuma longa.

3.1.1. Proximate analysis

In present study the composition list of turmeric for moisture content of turmeric was 11.80 ± 1.06% content of crude protein was 4.705±.75%, crude fat was 3.3±.29%, crude fiber was 5.7±.12 %while ash content was 3.96±.10 %and Nitrogen free extract was 71.92±1.58% (Table 1).

The findings of these contents are related to the findings of the Ashraf *et al*., (2016), he studied that the moisture content of turmeric was 12.36 ±0.53, crude protein was 4.83± 0.25, crude fat 3.42±0.17, crude fiber was 5.58±0.24, ash content was 3.89±0.15 and nitrogen free extract 69.92±2.58. The outcomes of this study is related to the outcomes of Nisar *et al*., (2015) performed proximate analysis and calculate results for the moisture content, crude fiber, crude fat, ash, crude protein and NFE value and the results are as follow for moisture it is 13.20% for NFE it is 69.05%, the crude fat content was 2.7%, while ash was 4.80 %, crude protein content was 6.47% and crude fiber was 4.80%. This study supported the result of present study because the results for different proximate compounds are closely related.

There are a lot of other studies which also support the results of the present study. Among all of them some are discussed here. In a study which was conducted on turmeric for its proximate profiling the trend for moisture, crude fat, crude protein, crude fiber, ash and NFE are very close to the present study (Lim *et al*., 2011).

3.1.2. Mineral Analysis

In present study the composition list of turmeric for mineral content of turmeric for calcium was 204.86±1.82 for potassium it was 289.18 ±7.19, for sodium it was 25 ±0.59 while the iron content of the turmeric was 8.43±0.40 (Table 2).

The findings of these contents are related to the findings of the Sultan *et al*., (2014), he find out the mineral content of the turmeric for calcium, potassim, iron and sodium is as follow 204.19±7.19, 287.13±12.92, 8.49±0.39 and 24.62±0.91 respectively.

Table 1 Composition of Turmeric

Parameters	(%)
Moisture	11.80±1.06
Crude protein	4.705±.75
Crude fat	3.3±.29
Crude fiber	5.7±.12
Ash	3.96±.10
Nitrogen free extract	71.92±1.58

Yousseuf *et al*., (2014) studied that the mineral content present in the dry turmeric was almost same to the mineral content of the present study. He studied that the calcium content of the dry turmeric was 228.8, for iron 11.03 and for sodium it is 228. So the results of Youssef work also support the present study.

Table 2 Mineral content

Minerals	mg/100g
Calcium (ca)	204.86 ± 1.82
Potassium (K)	289.18 ±7.19
Sodium (Na)	25 ±0.59
Iron (Fe)	8.43±0.40

3.1.3. Conventional antioxidant capability for different solvents

There are different types of methods for the extraction of bioactive moieties and for improving the antioxidant ability of the compound. The solvent extraction method was one of them. An imaginary picture can be drawn that there is a significant effect of percentage of the solvent while a highly significant effect of type of the solvent on extract of turmeric oxidation preventing profile. While, the relation or the interaction between percentage and type of the solvent was seen non-significant.

3.1.4. TPC

From table 4.3.1. An imaginary picture can be drawn from the statistical analysis that there is a significant effect of percentage of the solvent on the Total phenolic content while a highly significant effect of type of the solvent on the TPC. While, it has been observed that the interaction between percentage and type of the solvent was non-significant. Phenols relate health promoting effects has necessitated their quantification in the various food and food products. Internationally consumers are now gaining awareness day by day to the diet related health problems and shifting their diet pattern on natural plant based food and food products that are rich in polyphenolic compounds. Total phenolic compounds directly indicate the antioxidant activity. Total phenolic content of the ethanol, methanol and acetone extract of turmeric were measured by Folin's reagent. Results are presented as mg of gallic acid equivalent (GAE) per 100 gram of extracts. Total phenolic content (TPC) means related to three solvents at their different concentrations. The trending values for different which have been observed shows that the ethanolic extract of turmeric at the concentration of 70% gives the best result for TPC and its total phenolic content was 1006.56 ± 12.12 mg GAE/100mg followed by methanolic extract at the concentration of 70% gives the TPC value 599.62 ±6.56 GAE/100mg and from acetone the best extraction percentage was also 70 % and its TPC value was 594.94 ± 1.54 (Table 4).

Ashraf et *al*., (2016) also observed the effect of different solvents on total phenolic content of turmeric extract, in this study researcher observed that the highest value of TPC was with the ethanolic extract the detected value was 1110 ± 12 mg GAE/100g, followed by methanolic extract 545 ± 6 mg GAE/100g followed by thy acetonic extract 530 ± 4 mg GAE/100g. So this values also support the study.

In other study the researcher observed the effect of different solvents with different concentrations on total phenolic content of turmeric extract. He used three different solvent like methanol, ethanol and acetone and also seen the effect on different percentages of the solvent. In this study researcher find that the highest value of Total phenolic content was with the ethanolic extract the detected value was 609 ± 12 mg GAE/100g, followed by methanolic extract 534 ± 6 mg GAE/100g followed by thy acetonic extract 522 ± 10 mg GAE/100g. So these values also support the study.

Tiveron *et al.,* (2012) also performed the study related to the present study. They observed the effect of different concentrations of solvent on the total phenolic content of the turmeric. The result of their study supported the results of Total phenolic content of the present study.

Table 3 Table of variance for TPC

Source	Df	SS	MS	F
Percentage	2	135	67	4.05*
Solvent	2	997839	498919	29883.8**
Percentag*Solvent	4	15	4	0.23^{NS}
Error	18	300	17	
Total	26	998289		

*** Significant** ****highly significant** ^{NS} **Non significant**

Table 4 Total phenolic content of Turmeric (GAE /100g)

Solvent	Treatments			Mean
	T1 (50%)	T2 (70%)	T3 (90%)	
Methanol	**596.20 ± 6.05**	**599.62 ±6.56**	**594.72 ± 5.51**	**596.85b±6.04**
Ethanol	**1002.8 ± 10.20**	**1006.56 ± 12.12**	**998.71± 11.63**	**1002.68a±11.32**
Acetone	**592.49 ± 5.48**	**594.94 ± 4.54**	**591.84 ± 6.76**	**592.93b±5.59**
Mean	**730.49ab±7.24**	**733.31a±7.74**	**728.26b±7.96**	

3.1.5. Total Flavonoid Content (TFC)

From (table 5) An imaginary picture can be drawn from the statistical analysis that there is a significant effect of percentage of the solvent on the Total flavonoid content while a highly significant effect of type of the solvent on the TPC. While, it has been observed that the interaction between percentage and type of the solvent was non-significant. Phenols relate health promoting effects has necessitated their quantification in the various food and food products. Internationally consumers are now gaining awareness day by day to the diet related health problems and shifting their diet pattern on natural plant based food and food products that are rich in polyphenolic compounds. Total flavonoid compounds directly indicate the antioxidant activity. Total flavonoid content of the ethanol, methanol and acetone extract of turmeric was measured by Folin's reagent. Results are presented as mg of quercetin equivalent per gram of extracts. Total Flavonoid content (TFC) means related to three solvents at their different concentrations. The trending values for different which have been observed shows that the ethanolic extract of turmeric at the concentration of 70% gives the best result for TFC and its total phenolic content was75.14 ± 2.12 mg QE/g followed by methanolic extract at the concentration of 70% gives the TFC value 55.82±2.56 QEmg/g and from acetone the best extraction percentage was also 70 % and its TFC value was 35.14 ± 1.54 (Table 6).

The total Falvonoid content measured by the quercetin acid equivalent, AlCl3 reagent. The total flavonoid content in the extract was 22.52 ± 0.015, 79.36 ± 0.01 mg / g. The highest flavonoid content in the ethanol extract (79.36 ± 0.01 mg / g). From the results of this study, it can be seen that the highest content of flavonoids and phenolic compounds of gentian extract showed the greatest antioxidant activity, non-conventional species.

Table 5. Table of variance for TFC

Source	Df	SS	MS	F
Percentage	2	456.80	228.40	17.52**
Solvent	2	7200	3600	276.22**
Percentag*Solvent	4	2.17	5..44	0.00^{NS}
Error	18	234.59	13.03	
Total	26	7891.39		

*** Significant** ****highly significant** ^{NS} **Non significant**

Table 6 Total Flavonoid Content of Turmeric (GAE /100g)

Solvent	Treatments			Mean
	T1 (50%)	T2 (70%)	T3 (90%)	
Methanol	**45.49 ± 6.05**	**55.82±2.56**	**52.14± 2.51**	**51.15b±2.04**
Ethanol	**65.49 ± 3.20**	**75.14 ± 2.12**	**72.83± 3.63**	**71.15a±3.32**
Acetone	**25.49 ± 5.48**	**35.14 ± 4.54**	**32.82 ± 6.76**	**31.15b±2.59**
Mean	**45.49ab±3.24**	**55.14a±7.74**	**52.82b±2.96**	

3.1.5. Quantification by HPLC

If somebody desired to quantify the active functional compounds present in the turmeric high performance liquid chromatography is a very important tool to quantify and characterize the functional compounds. Need to quantify the curcumin from the turmeric is that we can use or find out the effective dose of curcumin for prevention or cure from different aliments.

3.1.6. Quantification of Curcumin by HPLC

An imaginary picture can be drawn from the statistical analysis that there is a significant effect of percentage of the solvent while a highly significant effect of type of the solvent on the quantification of the curcumin by high performance liquid chromatography. While, it has been observed that the interaction between percentage and type of the solvent was non-significant.

Conventionally formed extracts of turmeric, with different solvents, like methanol, ethanol and acetone at different percentages like 50%, 70 % and 90% are used to check the quantity of curcumin. The best results related to the quantity of the curcumin was seen with the conventional extract of turmeric with ethanol at the concentration of 70 % given the quantity 30.50 ± 1.78 mg/g as results explain that ability of ethanol for the extraction of curcumin is more than methanol and acetone as its polarity apt for its separation from raw material. It is followed by the second best quantity of curcumin from methanol at the concentration of 70 % and the quantity of curcumin is 28.05 ± 1.33 mg/g and the third best result come from 70% concentration of acetone and the result was as follow 23.45 ±.61mg/g.

In a study Ashraf *et al*., (2016) studied the effect of SFE supercritical fluid extraction and extraction

with conventional methods by using different solvents with different concentrations. He used ethanol, methanol and acetone just like the present study. Among all of the extracts which were conventionally extracted the highest yield was observed from ethanol at the concentration of 70% was 31.48 ± 1.35 mg/g while third best yield was seen with the 70% acetone and quantity of curcumin was 23.12 mg/g while 70% methanol gives the 2nd best results that were 28.75 ± 1.12 mg/g.

The present research is also in linked with the study of Tayyem *et al.,* (2006) he studied the the amount of curcumin which is 31.4mg/g in dry turmeric in methanolic extract from the pure form of the turmeric. The findings of all the studies support that the present work was performed according to the previous work.

Table 7. Analysis of Variance Table for the quantification of curcumin by HPLC

Source	Df	SS	MS	F
Percentage	2	511.06	255.53	61.30**
Solvant	2	273.82	136.91	32.84**
Percentag*Solvant	4	19.84	4.96	1.19^{NS}
Error	28	75.03	4.17	
Total	26	879.78		

**** Highly significant** ^{NS} **Non significant**

Table 8. for treatment means of quantification of Curcumin by HPLC mg/g

	Treatments			
Solvents	**T1 (50%)**	**T2 (70%)**	**T3 (90%)**	**Mean**
Methanol	14.59 ± 3.23	28.05± 1.33	19.93 ± 2.02	**20.86**^{b}
Ethanol	21.84 ± 2.49	30.50 ± 1.78	25.52± 1.16	**25.95**^{a}
Acetone	13.79± 2.40	23.45^{b} ±.61	17.63 ± 0.91	**18.29**^{c}
Mean	**16.74**^{c}	**27.55**^{a}	**21.03**^{b}	

3.2. Antioxidant potential

Antioxidant potential is basically the oxidation preventing capability of any compound. It's the ability of the compound to prevent the body from harmful effects of oxidation by scavenging the free radicles or by stopping the production of free radicles. The antioxidant ability of turmeric can be finding out by different methods like DPPH, FRAP etc.

3.2.1. DPPH Assay

A picture can be drawn from the statistical analysis that there is a highly significant effect of percentage of the solvent on the total DPPH and also have the highly significant effect of type of the solvent on the DPPH. While, it has been observed that the interaction between percentage and type of the solvent was non-significant.

Nine types of treatments were used to check the DPPH value. DPPH value was checked by three concentrations of methanol, 50, 70, 90 % ethanol 50. 70 and 90 % and after that with acetone using the same three percentages. The trending values for different solvents which have been observed shows that the ethanolic extract of turmeric at the concentration of 70% gives the best result for DPPH and its maximum value was 66.58 ±2.89% followed by methanolic extract at the concentration of 70% gives the DPPH value 63.06a±2.26% and from acetone the best extraction percentage was also 70 % and its DPPH value was 42.96 ±2.16 (Table 10).. The effects of ethanol, methanol and water on the extraction efficiency of gingerol show that the ethanol extract exhibits more phenolic and antioxidant potential. It is precisely because of the reason for the capture of free radicals in conjugated structures, recognizing the ability of ethanol to isolate and the ability to extract curcumin chains (Nisar et al., 2015).

Ashraf et *al*., (2016) also observed the effect of different solvents on total phenolic content of turmeric extract, in this study researcher observed that the highest value of DPPH was with the ethanolic extract the detected value was 65.71 ± 3.40 %, followed by methanolic extract 59.82 ± 2.51% followed by the minimum quantity by acetonic extract 48.71 ± 2.01 %. so this values also support the present study.

Table 9. Table of Variance for DPPH value of Turmeric

Source	df	SS	MS	F
Percentage	2	892.22	446.11	79.65**
Solvant	2	3303.25	1651.62	294.90**
Percentage*Solvant	4	52.71	13.18	2.35^{NS}
Error	18	100.81	5.60	
Total	26	4348		

Table 10. Table for treatment means of DPPH (%)

Solvents	Treatments			Mean
	T1 (50%)	T2 (70%)	T3 (90%)	
Methanol	51.80±2.74	63.06±2.26	54.49±2.03	**56.45b±**
Ethanol	50.73±2.5	66.58 ±2.89	61.03±2.15	**59.45[a]±**
Acetone	27.97±2.20	42.96±2.16	32.96±2.24	**34.93[c]±**
Mean	**43.50[c]±**	**57.53[a]±**	**49.50[a]±**	

3.2.3. FRAP

From the statistical analysis it can be seen that there is a highly significant effect of percentage of the solvent on the total FRAP value and also have the highly significant effect of type of the solvent on the TPC. While, it has been observed that the interaction between percentage and type of the solvent shows unimportant relation (Table 11).

Different types of treatments were used to check the FRAP value. Methanol, Ethanol and Acetone as solvents were used with the con centration of 50%. 70% and 90%. The trending values for different solvents which have been observed shows that the ethanolic extract of turmeric at the concentration of 70% gives the best result for FRAP and its maximum mean was 207.53 ±3.32 followed by methanolic extract at the concentration of 70% gives the FRAP mean172.25±3.79 and from acetone the best extraction percentage was also 70 % and its FRAP content was150.56± 5.11 (Table 12).

To endorsed the result of the present study another study was discussed there Ashraf *et al*., 2016. Studied the values of FRAP was highest with ethanol 212.89±9.95, for methanol it was 159.08±6.71and from acetone 149.63 ±4.94. Tiveron et al. (2012), observed the value of FRAP in turmeric powder as 169.1 µmol Fe2+/g dry weight. The effects of ethanol, methanol and water on the extraction efficiency of gingerol show that the ethanol extract exhibits more phenolic and antioxidant potential. It is precisely because of the reason for the capture of free radicals in conjugated structures, recognizing the ability of ethanol to isolate and the ability to extract curcumin chains (Nisar et al., 2015).

Conclusively the results of present study and all above mentioned studies shows that the type of the solvent and the concentration of solvent effects the antioxidant ability and the FRAP value of the curcumin.

Table 11: Source of variance table for FRAP (µM Fe^{2+}/g)

Source	df	SS	MS	F
Percentage	2	17084.5	8542.27	453.94**
Solvant	2	2749.2	1374.58	73.05**
Percentag*Solvant	4	102.8	25.70	1.37^{NS}
Error	18	338.7	18.82	
Total	26	20275.2		

** **Highly significant** ^{NS} **Non significant**

Table 12. Means for the concentration of FRAP (µM $Fe2^{2+}$/g)

Solvents	Treatments			Mean
	T1 (50%)	T2 (70%)	T3 (90%)	
Methanol	149.52 ± 6.52	172.25±3.79	165.65[d]±3.71	**176.78±4.67**
Ethanol	184.78±4.83	207.53[a]±3.32	197.46 ±2.40	**196.59±3.51**
Acetone	121.95.± 4.02	150.56± 5.11	132.78±4.05	**135.10±4.39**
Mean	**152.08±5.12**	**176.78±4.07**	**165.30±3.38**	

4. Conclusion

Turmeric and its bioactive compounds like curcumin had great therapeutic abilities against many diseases. Curcumin, the main bioactive component of turmeric have wide spectrum of biological actions viz. antiinflammatory, antioxidant, anticarcinogenic, antidiabetic and antimicrobial activities.

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