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EVALUATION OF ANTIOXIDANT POTENCY OF SORGHUM BRAN NANOPARTICLES

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Abstract

Medicinal plants are being widely used in India directly in folk medicine. Burgeoning interest in herbal plants has increased scientific scrutiny for their therapeutic potential and safety. In spite of advances made available in allopathic medicine, so far no effective anticancer drugs are available due to its side effects. Sorghum bicolor is commercial plant in India. The grains are used as source of food, whereas the bran is usually discarded as waste. The bran is rich in anthocyanins. The anthocyanins are isolated, its efficacy as nanoparticle and antioxidant is evaluated in the present study. The observations of the study confirms the antioxidant nature of the nanoparticles of sorghum bran.

Keywords: Sorghum bran, nanoparticles, antioxidants.

Introduction

Medicinal plants have been used since from the beginning of human life and these form the basis for the development of modern medicine.Medicinal plants usage for human is a result of many struggles against illness from whichthe mankind learned to pursue drugs in bark, seeds, fruit bodies and other parts of plants.Medicinal plants are the main resources in almost all the cultures by ensuring its safety, quality and effectiveness. Development of novel drugs from herbal drugs can help in the healthcare system to treat various human diseases in future (FatemehJamshidi Kia *et al.*, 2018).

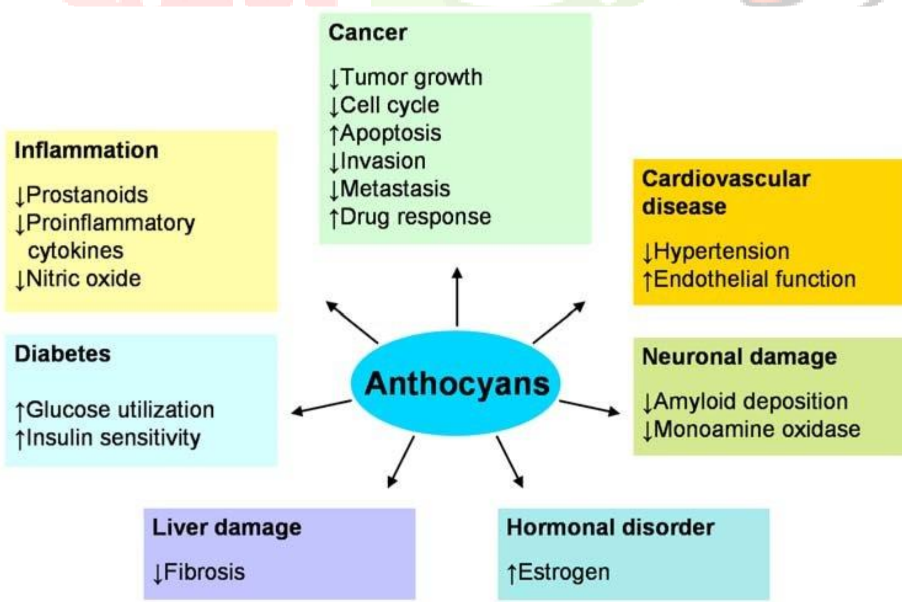
According toWorld Health Oranganisation, 70% of the population world- wide are the plants for their primary health care treatment and 35,000-75,000 of plants are used as medicines either as a whole or in extracted form.Most of the chemotherapeutic drugs are identified and isolated from the plants which are widely used in the treatment of cancer.

Sorghum is a the world's fifth largest produced cereal after maize, rice, wheat and barley. In Africa it is the second produced cereal after maize and the production of the sorghum is almost one half of the world crop production (FAOSTAT data,2016).Pharmacological research have also reported the effects of sorghum and its extracts on cardio vascular disease prevention, cancer cell inhibition and glycemic control .Almost all kinds of phenolic are found in sorghum and much more are present in their outer layer (bran)(Xiaoping luo*et al.*,2017).

Sorghum bran contains a phenolic compounds in the form of phenolic acids, flavonoids and condensed tannins which have antioxidant activity.It is genetically diverse compound and some species have high amount of polyphenols.It is also reported that high amount of polyphenols components are with strong anticancer activity .Many of the grains are not evaluated in the health promotion potential even though there are approximately 40,000 of sorghum accessions. In the traditional medicines sorghum based foods such as teas, beers and extracts are finding an importance on understanding the increased biological effects of sorghum(BasharatYousuf*et al.*,2016).

Anthocyanin's are the poly phenolic pigments that belongs to a flavonoid group and it is responsible for the red-orange to blue-violet colours present in plant organs.Epidemiological studies suggested that the high consumption of anthocyanin may lower the risk of various diseases.The pigments in the anthocyanin's are in glycosylated form. Among these cyaniding-3-glucoside is the major anthocyanin found in most of the plants (McGinnis and Painter ,2020).

Earlier, anthocyanin is only known for the coloring properties and now anthocyanin plays an important role in the health benefits as dietary antioxidants by preventing neuronal diseases, cancer ,diabetes, cardiovascular illness, inflammation and many other diseases.



With this objective, the present work aims to isolateanthocyanins from Sorghum bran modify it to a nanoparticle using ZnO and evaluate the antioxidant efficacy of the anthocyanin nanoparticle.

Methodology

Preparation Of Extract Of The Sample

The Sorghum plant was collected from farming land in Coimbatore. The grains in the plants are removed and the bran is separated from the plant. The obtained bran was powdered. 10g of bran powder were taken in a conical flask for sample extraction by using 100ml of chloroform solvent for 72hrs.After the incubation, the extract was air dried. The crude that wasobtainedwas dissolved in water and used for studies..

Synthesis Of Zinc Oxide Nanoparticles

In a typical reaction mixture ,5-10 ml of the aqueous extract of red sorghumbran was added to 300 ml of 4Mm of aqueous zinc sulphate heptahydrate solution and stirred at room temperature for 5 min s to achieve the pale yellow solution. After that, 1M sodium hydroxide solution is added to the mixture drop by drop with continuous stirring at room temperature. The yellow color of the above mixture starts change to yellowish suspension at pH 12. The suspended particles were purified by dispensing in sterile distilled water amd centrifuged thrice. Futher, the white precipitate particles were washed with ethanol to remove the impurities for the final product. The white powder was obtained after drying at 60ºC invaccum oven for 6 hrs.

The synthesised nanoparticles was characterised using UV – Vis and FITR processes.

Analysis OfAntioxidant Potency in the ZnO NP Extract

Enzymatic Antioxidant

Catalase activitywas determined by the method of Sinha, (1972), SOD was determined by the method of Kakkar*et al.*, (1984).

Non Enzymatic Antioxidants

Ascorbic acid was determined by Roe (1960), GSH (Moron *et al.*,1979) and Vitamin E by Dipyridyl method.

Results and Discussion

UV-Vis analysis of ZnONPs

ZnONPs formation was confirmed with the appearance of the turbidity in the solution and change in the surface Plasmon Resonance (SPR) UV-vis spectroscopic analysis.

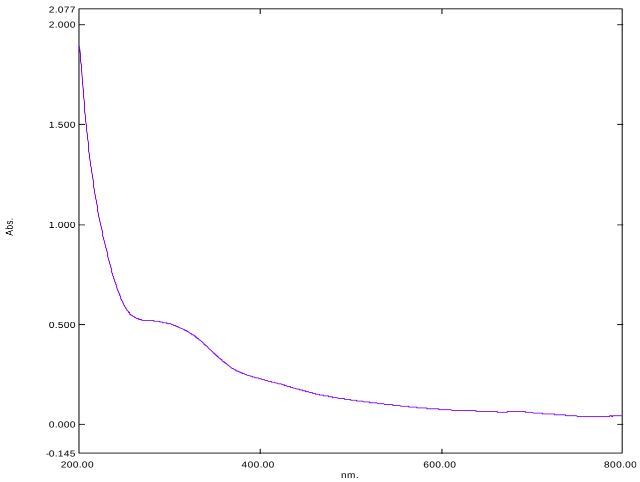


Figure – 1 – UV – Vis Spectrum of Nanoparticles

The presence of ZnONP's was detemined by the peak at 300nm. This confirms the presence of ZnO nanoparticle. Studies by Fahimmunisha *et al.*,(2020) suggests that formation of nanoparticle is characterised by the paek at 300 – 400nm.

The FTIR spectra of red sorghum barn is depictedin Figure 4.1.2.1. shows that an absorption band at 3749.62 represent the O-H stretching of monomers. The absorption bands at 3417.86 and 2924.09 representing O-H and C-H stretching of polypols. The peak in the range of 2376.30 corresponds to the O-H stretches. The absorption peak is located at 1651.07 represents C=C stretching vibration of aromatic rings. Stretching vibration present at 1427.32 and 1157.29 are associated with O-H and C-OH polypols. The absorption band at 1041.56 and 894.97 represents C-N stretching and N-H was of amines respectively. The peaks in the region between 600 and 400 are alloted to Zn-O. The band at 462.92 confirms stretching vibrations of zinc oxide nanoparticles.

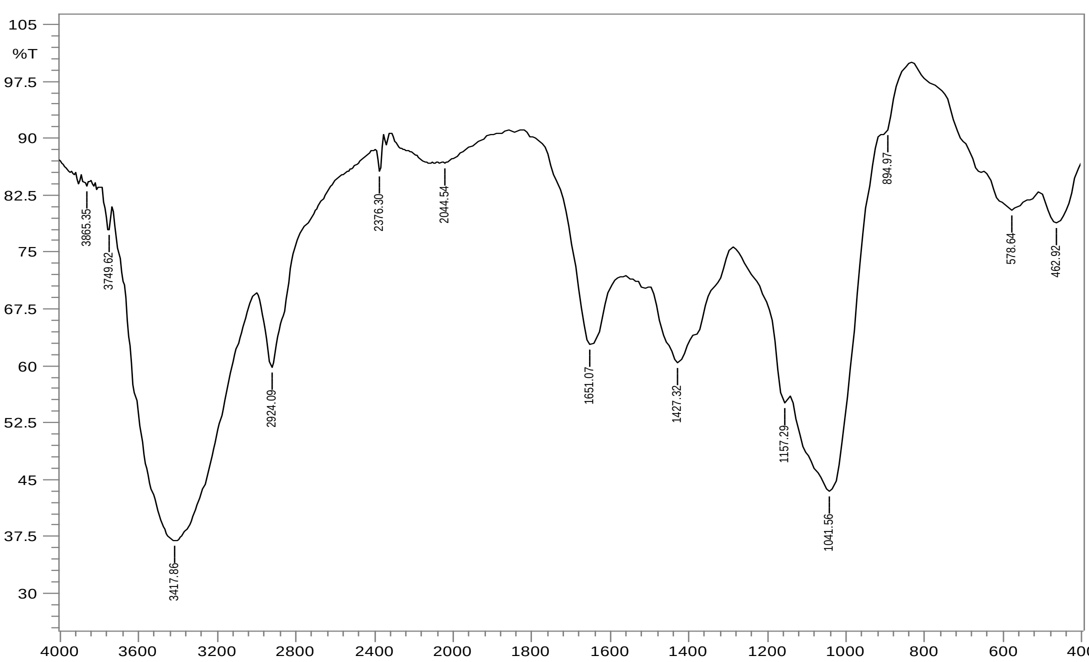


Figure 2- FTIR Pattern of Nanoparticle

Enzymic & Non – Enzymic Antioxidants

Free radicals have an unpaired electron in the outermost orbit and they can be either reactive oxygen species (ROS) or reactive nitrogen species (RNS). Prolonged exposure to metabolically derived reactive oxygen species (ROS) can cause an imbalance between radical species and *in vivo* physiological antioxidant defences. A redox balance between the free radicals and antioxidants should be maintained. If this is not maintained due to either decreased antioxidant content or excessive free radicals, oxidative stress condition prevails, which is mainly involved in the pathogenesis of variousdiseases.

Enzymic Antioxidants

Enzymatic antioxidants are the substances that occurs in very low concentrations and it has a role to inhibit the oxidation of a molecule, caused by free radicals in the living organisms. The key enzymatic antioxidants of this defense system include SOD, GPx, and catalase. Enzymatic antioxidants acts by detoxifying the free radicals and protecting the body.

Table 1- Activates of Enzymic Antioxidants in Nanoparticles

S.No	Parameters	Activity (U/mg)
1	Catalase	2.58±0.54
2	Superoxide Dismutase	1.40±0.02

Catalase catalyses the conversion of hydrogen peroxide into water and oxygen. Superoxide dismutase plays an physiological role in mitigating deleterious effect of ROS.Deficiency of catalase may leads to various degenerative diseases like diabetes mellitus, hypertension. Anemia, vitiligo, bipolar diseases, cancer.It is reported that SOD liposome and mimetics are effective in cancer prevention especially in animal model.Recent study revealed that SOD inhibits not only oncogenic activity, but also subsequent metabolic shifts during early tumorigenesis(Vermont*et al*.,, 2016)

Non Enzymatic Antioxidants

Non-enzymatic antioxidants are the low molecular substances such as Glutathione, ascorbic acid, vitamin E that acts as various scavengers for different types of reactive oxygen species.

Ascorbic acid is considered as the most important water soluble antioxidant in extracellular fluids. It capable of neutralizing ROS before lipid peroxidation is initiated.The concentration of ascorbic acid in ZnONP's of red sorghum bran was found to 91.23±1.29 mg/dl.Ascorbate has been demonstrated to be an effective antioxidant. It can act both directly, by reaction with aqueous peroxyl radicals, and indirectly, by restoring the antioxidant properties of fat-soluble vitamin E. The overall consequence of these antioxidant activities is the beneficial control of lipid peroxidation of cellular membranes including those surrounding as well as within intracellular organelles. Intracellular free radical attack on non-lipid nuclear material may also be diminished (.Bendich, 1986).

Table 2- Levelof Non - Enzymic Antioxidants in Nanoparticles

S.No	Parameters	Concentration (mg/dl)
1	Ascorbic acid	91.23±1.29
2	Vitamin E	0.81±0.06
3	Glutathione	5.00±0.50

Vitamin E is the major lipid-soluble component in the cell antioxidant defence system and is exclusively obtained from the diet. It has numerous important roles within the body because of its antioxidant activity. Oxidation has been linked to numerous possible conditions and diseases, including cancer, ageing, arthritis and cataracts; vitamin E has been shown to be effective against these. Platelet hyperaggregation, which can lead to atherosclerosis, may also be prevented by vitamin E; additionally, it also helps to reduce the production of prostaglandins such as thromboxane, which cause platelet clumping. Vitamin E is present in natural foods or used in commercially available products as a dietary supplements.α tocopherol is the primary form of Vitamin E used by human body for the dietary requriments. The concentration of α tocopherol was found to be 0.81±0.06 mg/dl in the nanoparicles.

Mammalian cells have evolved protective mechanisms to minimize injurious events that result from toxic chemicals and normal oxidative products of cellular metabolism. A major endogenous protective system is the glutathione redox cycle . Glutathione is present in high concentrations as GSH in most mammalian cells (generally in the millimolar range), with minor fractions being GSSG, mixed disulfides of GSH and other cellular thiols, and minor amounts of thioethers.GSH acts both as a nucleophilic "scavenger" of numerous compounds and their metabolites, via enzymatic and chemical mechanisms, converting electrophilic centers to thioether bonds, and as a substrate in the GSH peroxidase-mediated destruction of hydroperoxides. GSH depletion to about 20-30% of total glutathione levels can impair the cell's defense against the toxic actions of such compounds and may lead to cell injury and death (Reed., 1990)5.00±0.50 mg/dl

Conclusion

In our present study, the levels of enzymic and non-enzymic antioxidants were identified in the nanoparticles of sorghum bran. The nanoparticles were confirmed by UV – Vis and FITR studies. The observed antioxidant property might be attributed to the anthocyanin present in the bran. Although, from the preliminary study, it was able to establish the antioxidant efficacy of nanoparticles of sorghum bran, further characterization is yet to be established.

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