Comparative Evaluation of Antioxidant, Antibacterial, Enzyme Inhibitory and Anti-Inflammatory Activities of Fresh and Oven-Dried Cocos Nucifera Sprouts

[1] K. Kavitha & [2] P. Jayasri
[1] Associate Professor, [2] Research Scholar
[1,2]Department of Foods and Nutrition, Vellalar College for Women

Abstract: The potential source of natural polyphenols, free radicals scavenging activities, antibacterial activities and anti-inflammatory activities in the fresh and dried Cocos nucifera sprouts were studied. The primary and secondary phytochemical constituents of fresh and dried C.nucifera sprouts were estimated using standard procedures. Antioxidant activity using DPPH, Nitric Oxide, Superoxide and Hydroxyl radical scavenging methods, antibacterial activity using disc diffusion test and anti-inflammatory activity through egg albumin denaturation were carried out. The presence of essential phytoconstituents, were observed in qualitative phytochemical screening. In the quantitative analysis, it was noted that presence of maximum phenolic compounds (2.85 mg/g), flavonoids (2.10 mg/g), alkaloids (0.76 mg/g/), tannins (0.28 mg/g) and glycosides (0.19 mg/g) in fresh and dried C.nucifera sprouts. Antioxidant and anti-inflammatory activities have shown more potent in the therapeutic applications. The antibacterial effect shows minimum zone of inhibitions by E.coli and Staphylococcus.The fresh and dried C.nucifera sprouts is a natural and nutrient dense food and good sources of functional components, antibacterial, anti-inflammatory properties and more effective to scavenge free radicals.

Keywords: Cocos nucifera, phytochemicals, antibacterial activity, antioxidant activity, anti-inflammatory activity.

Introduction

Cocos nucifera (L.), belonging to the family Arecaceae and commonly known as the coconut tree, is an important member of the palm family. The coconut tree is often referred to as the “tree of life” because nearly all parts of the plant are beneficial to humans. It is widely cultivated in tropical regions across the world and produces fruit throughout the year. Among the various components of the coconut tree, the coconut

haustorium, also known as the “coconut apple” or coconut sprout, has recently gained considerable attention due to its nutritional, functional, and physicochemical properties.

The coconut fruit contains two types of endosperm: coconut water and the solid coconut kernel. The kernel, which is rich in carbohydrates, fats, proteins, fibre, and minerals, plays a crucial role in supporting embryo development during the early stages of germination. As germination begins, the embryo grows in two directions: the shoot develops upward, while the basal portion differentiates into the haustorium, a soft, spongy, and absorbent tissue. This structure utilizes nutrients from both the coconut water and the solid endosperm. Over a period of 20–24 weeks, the haustorium expands and eventually fills the entire cavity of the coconut shell[1].

Functionally, the coconut sprout acts as a cotyledon, nourishing the developing embryo. During germination, stored lipids in the endosperm are converted into soluble sugars, which provide the energy required for seedling growth[2]. Concurrently, complex macromolecules undergo enzymatic degradation: polysaccharides are broken down into oligosaccharides and monosaccharides, fats into free fatty acids, and proteins into oligopeptides and free amino acids. These transformations enhance the bio-efficiency of digestive enzymes involved in carbohydrate, lipid, and protein metabolism.

Sprouted seeds are widely consumed across the globe and are produced from a variety of plant sources such as adzuki beans, coconut, broccoli, buckwheat, cabbage, chickpeas, lentils, mung beans, soybeans, sunflower, fenugreek, wheat, and several others[3]. Among these, coconut sprouts are nutritionally rich, containing substantial amounts of proteins, essential minerals, polyphenols, alkaloids, and antioxidants. These bioactive compounds contribute to their antibacterial, anti-inflammatory, antioxidant, and immune-boosting properties[4].

Extensive research on C. nucifera has demonstrated a wide spectrum of biological activities, including anthelmintic, anti-inflammatory, antinociceptive, antioxidant, antifungal, antibacterial, and antitumor effects. Additional pharmacological properties such as antihypertensive, cardioprotective, hepatoprotective, nephroprotective, vasodilatory, anti-seizure, cytotoxic, and anti-osteoporotic activities have also been reported. These effects vary depending on the plant part evaluated, as each part of C. nucifera contains distinct phytoconstituents[5].

The coconut haustorium is particularly valued for its role in nutrient mobilization and metabolic regulation. Studies indicate that it retains significant levels of minerals, starch, and phenolic compounds throughout the germination process, thereby maintaining its

nutritional quality[6]. During germination, the haustorium absorbs triacylglycerols from the endosperm and converts these lipids into sugars, which serve as an essential energy source for the developing embryo[7]. Additionally, secondary metabolites such as cardiac glycosides have been identified in the haustorium, suggesting potential therapeutic applications in cardiovascular diseases and certain cancers[8].

Traditionally, coconut sprouts have been consumed by various populations to reduce the risk of gastrointestinal disorders. One such condition is peptic ulcer disease, which may be caused by infection with Helicobacter pylori or by adverse reactions to non-steroidal anti-inflammatory drugs affecting the stomach or duodenum[9]. Furthermore, bioactive constituents present in the coconut haustorium have demonstrated antiepileptic and antitumor activities, with the potential to inhibit cancer progression at multiple stages of development[10].

The aim of the research was to scientifically validate the medicinal potential of coconut sprouts by analyzing their bioactive compounds and evaluating their antioxidant radical scavenging activity, anti-inflammatory activity, enzyme inhibitory activity, and antibacterial efficacy of coconut sprouts, thereby supporting the consumption of coconut sprouts in the form of fresh or dried may serve as an economical and natural dietary source for improving human health.

Materials and methods

Sample collection

Fresh samples of C.nuciferaspout procured from farmers, remove adhering impurities, and authenticated. A fresh portionof sprouts was used for extraction. The remaining portion was subjected to oven drying for preparation of dried samples.The cleaned samples were cut into uniform pieces and dried in a hot air oven at 50–55 °C until a constant weight was achieved. The oven-dried samples were allowed to cool to room temperature, powdered using a mechanical grinder, and stored in airtight containers. Oven drying was employed to minimize microbial growth while preserving phytochemical constituents[10,12].

Qualitative Phytochemical Screening

Preparation of Extracts

Approximately 10 g of fresh sample and 10 g of oven-dried sprout were extracted with 100 mL of methanol by maceration for 48 h at room temperature with intermittent shaking. The extracts were filtered using Whatman No. 1 filter paper and concentrated. The filtrates were stored at 4 °C and used for qualitative phytochemical screening.

Qualitative phytochemical screening of methanolic extracts of fresh and oven-dried Cocos nucifera (L.) sprouts was carried out to detect the presence of major bioactive constituents using standard protocols. The extracts were tested for tannins and phenolic compounds using ferric chloride test, saponins by the foam test, flavonoids using the alkaline reagent test, alkaloids using Mayer's and Wagner's reagents, glycosides by the Keller–Killiani test, terpenoids andphytosterols using the Salkowski test, and general phenolics by ferric chloride reaction. The development of characteristic color changes or precipitate formation was considered as indicative of the presence of the respective phytochemical groups. The results were recorded qualitatively as present (+) or absent (–) for both fresh and oven-dried samples in accordance with established phytochemical screening methods[11,12,13].

Quantitative Phytochemical Screening

Quantitative estimation of major phytochemical constituents in fresh and oven-dried C.nucifera sprout extracts was performed using standard spectrophotometric methods. Total phenolic content was estimated by the Folin–Ciocalteu method and noted as mg gallic acid equivalents (GAE) per g of extract, while total flavonoid content was estimated using the aluminium chloride colorimetric method and stated as mg quercetin equivalents (QE) per g of extract. Total tannins(Folin–Denis method), and saponin content(gravimetrically)was estimated. Alkaloid content was estimated by acid–base precipitation, and total terpenoids were quantified using a colorimetric method based on phosphovanillin reaction. All analyses were performed in triplicate, and the values were explicited as mean ± standard deviation following established procedures[12,13,14].

In Vitro antioxidant studies of Fresh and Dried C.nucifera sprout

In vitro antioxidant activities of fresh and dried C.nucifera sprout were carried out using standard procedures. The scavenging of free radicals such as DPPH[15], Nitric oxide[16], Superoxide[17], Hydroxyl radical[18], Hydrogen peroxide[19]and $ABTS^{+}$Scavenging[20]were determined with the concentration of 50 to 250 mg/g against the standard and IC_{50} values were calculated using formula.

Antibacterial activity

The antibacterial activity offresh and dried C. nucifera sprout extractsagainst the strains of E. coli and Staphylococcus were estimated[21].

Enzyme inhibitory activity of α-amylase and α-glucosidase

The enzymes such as α-amylase and α-glucosidase inhibitory activity of fresh and dried C. nucifera sprout were determined by suing standard procedure[22].

Anti-inflammatory assay (Inhibition of the albumin denaturation)

The reaction mixture consisting of sample fresh and dried C. nucifera sprout flour extract of different concentrations (100–500µg) was carried out and percent inhibition of protein denaturation was calculated using the formula[23,24].

Results and Discussion

Qualitative Phytochemical analysis

The aqueous extract of fresh and dried C.nucifera sprout was analyzedand the table I demonstrated the presence of phytoconstituents such as tannins, saponins, flavonoids, alkaloids, glycosides, phenolic compounds, phytosterols, terpenoids and steroids.

Table I: Phytochemical analysis of fresh and dried C.nucifera sprout

S.No.	Phytochemical constituents	Fresh	Dried
1.	Tannins	+	+
2.	Saponins	+	+
3.	Flavonoids	+	+
4.	Alkaloids	+	+
5.	Glycosides	+	+
6.	Phenolic compounds	+	+
7.	Phytosterols	-	+
8.	Terpenoids	+	+
9.	Steroids	+	+

(+) presence; (-) absence

Quantification of phytochemicals

The phytochemical constituents were quantified and the values are given in tale II.

Table II: Quantification of fresh and dried C.nucifera sprout

S.No.	Phytochemical constituents	Fresh sprout (mg/g) *	Dried sprout flour (mg/g) *
1.	Tannins	0.24± 0.9	0.28 ± 1.1
2.	Saponins	0.07± 1.1	0.09 ± 1.3
3.	Flavonoids	1.98± 0.8	2.10 ± 0.9
4.	Alkaloids	0.62± 0.1	0.76 ± 0.1
5.	Glycosides	0.16± 1.4	0.19 ± 1.3
6.	Phenolic compounds	2.73± 0.6	2.85 ± 0.8
7.	Terpenoids	0.04± 1.3	0.05 ± 1.25
8.	Steroids	0.002± 0.1	0.003 ± 0.1

*Mean ± S.D ($p < 0.001$)

The quantitative phytochemical estimationindicates that the phenolic compounds (2.73 ± 0.6 mg/g in fresh sprout and 2.85 ± 0.8 mg/g in dried sprout flour)and flavonoids (1.98± 0.8 mg/g in fresh sprout and 2.10 ± 0.9mg/g in dried sprout flour)were the predominant phytochemicals in both samples, with phenolics showing the highest levels, suggesting strong antioxidant potential.These compounds are widely recognized for their antioxidant and free radical–scavenging properties and plays a vital role in the prevention of oxidative stress–related disorders[25,26]. Alkaloids and glycosides were present in moderate amounts, indicating potential physiological activities such as enzyme inhibition, antimicrobial and cardioprotective effects, as documented in earlier phytochemical studies[12,27]. Tannins, saponins and terpenoids were detected in lower amounts, yet their presence is nutritionally significant due to their reported roles in antimicrobial activity, cholesterol-lowering effects and anti-inflammatory responses[28]. Steroids were detected only in trace quantities in both fresh and dried samples, which are consistent with reports that plant steroids generally occur at low levels but contribute to membrane stability and bioactivity[29]. Overall, the results observed that enhancement of phytochemical content in dried sprout flour support its suitability as a concentrated source of bioactive compounds. The results on par with findingsthat drying, when properly controlled, can improve phytochemical retention and functional potential, thereby reinforcing the applicability of dried sprout flour as a functional and nutraceutical ingredient[26,30].

Antioxidant activity

DPPH Radical Scavenging activity of Fresh and Dried C.nucifera sprout

The DPPH radical scavenging assay presented in figure 1 revealed a concentration-dependent increase in antioxidant activity for the standard ascorbic acid, fresh coconut sprout, and dried coconut sprout flour across the concentration ranges from 50 to 250 mg/g, with statistically significant at ($p < 0.001$). The fresh coconut sprout exhibited inhibition ranges from 13.47 ± 0.06 mg/g to 78.20 ± 0.10 mg/g whereas the dried coconut sprout flour exhibits from 29.09 ± 0.10 mg/g to 125.1 ± 0.20 mg/g and the standard ascorbic acid recorded from 39.87 ± 0.24 mg/gto 132.6 ± 0.24 mg/g at the concentration from 50 to 250 mg/g respectively. The percent of DPPH scavenging effect increases with the concentration of samples as well as in standard from 50 mg to 250 mg/g[31].The reduced scavenging efficiency of the fresh sprout at lower concentrations associated with to its higher moisture content and limited availability of extractable phenolic compounds[32]. The enhanced activity of the dried sample indicates that drying facilitates concentration and stabilization of antioxidant compounds, a phenomenon also observed in dried plant matrices[33].

Dried coconut sprout flour exhibited a lower IC_{50} value of 93.5 ± 0.24 mg/g compared to fresh sprout with 163.10 ± 0.10 mg/g, indicating superior radical scavenging efficiency. Lower IC_{50} values reflect higher antioxidant potency[34]. The relatively higher IC_{50} of the fresh sprout suggests reduced effectiveness due to moisture-induced dilution and enzymatic oxidation of phenolic compounds.

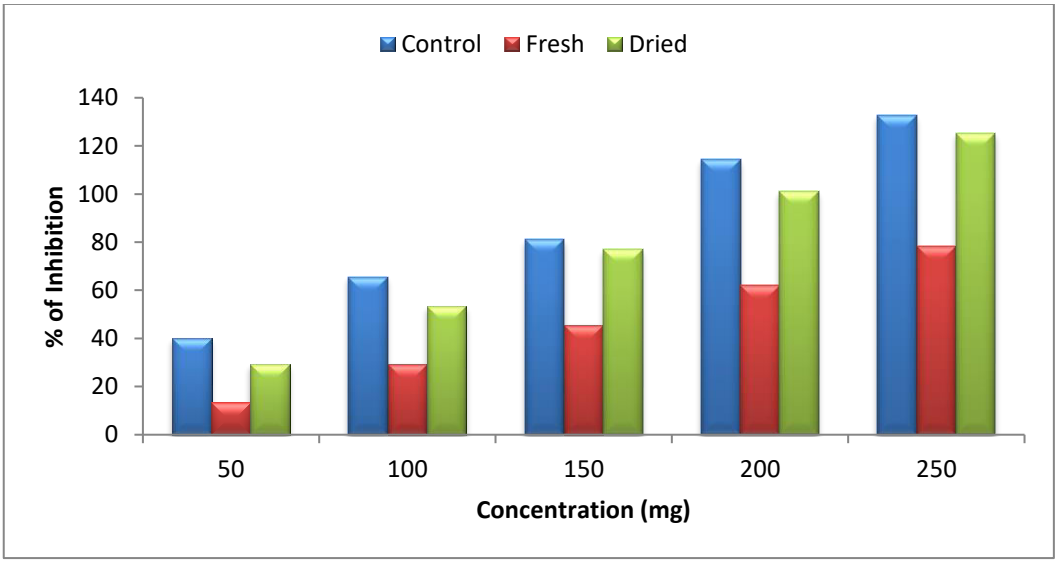

Figure 1 DPPH radical scavenging activity

Nitric Oxide Radical Scavenging activity of Fresh and Dried C.nucifera sprout

The nitric oxide radical scavenging activity given infigure 2 revealed a concentration-dependent increase for the standard ascorbic acid, fresh and dried coconut sprout flour across the concentration ranging from 50 to 250 mg, with significance observed at($p < 0.001$). The fresh coconut sprout recorded inhibition ranges from 11.73 ± 0.06 mg/g to 76.17 ± 0.15 mg/g and for the dried coconut sprout exhibits 26.23 ± 0.15 mg/g to 111.67 ± 1.53 mg/g at the concentration from 50 to 250 mg/g, at the same time the standard ascorbic acid exhibits scavenging free radicals from 28.93 ± 0.17 to 117.87 ± 0.57 mg/g.A similar dose-responsive pattern in nitric oxide scavenging capacity has been reported for plant-derived antioxidant extracts[35].Furthermore, dried coconut sprout flour exhibited a lower IC_{50} value of 104.23 ± 0.32 mg/g, indicating greater nitric oxide scavenging efficiency when compared with fresh sprout at 173.17 ± 0.21 mg/g. Lower IC_{50} values are indicative of stronger free radical neutralization capacity[36].

The superior nitric oxide scavenging activity observed in dried coconut sprout flour can be ascribed to moisture removal during drying, which concentrates phenolic compounds, enhances extractability of bioactive constituents, and limits enzymatic degradation. Comparable improvements in antioxidant activity following drying of

coconut sprouts[37]. Conversely, the relatively lower activity of fresh sprout may be linked to the presence of active oxidative enzymes and higher water content, which can negatively affect phenolic stability.

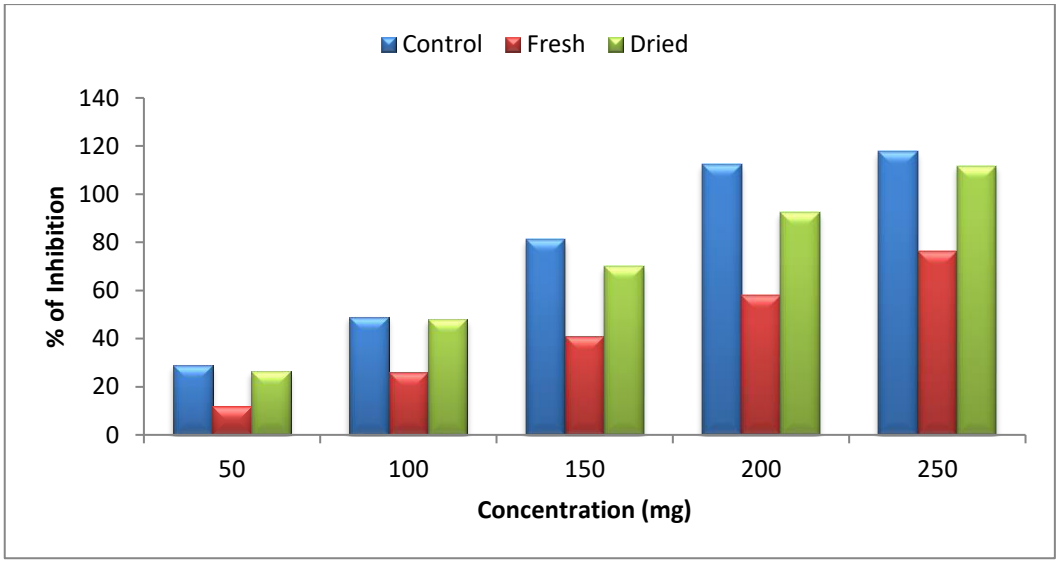

Figure 2 Nitric oxide radical scavenging activity

Superoxide Radical Scavenging activity of Fresh and Dried C.nucifera sprout

From the figure 3, the assessment of superoxide radical scavenging activity indicated a significant and concentration-dependent increase in antioxidant activity for the reference control, fresh coconut sprout, and dried coconut sprout flour across concentrations ranging from 50 to 250 mg, with statistical significance at ($p < 0.001$). The fresh coconut sprout exhibitsscavenging free radicals ranges from13.07 ± 0.06 mg/g to 77.83 ± 0.06 mg/g, the dried coconut sprout flour possess from 28.63 ± 0.06 mg/g to 117.67 ± 0.58 mg/g, whereas the standard ascorbic acid ranges from 30.17 ± 0.09 mg/g to 120.78 ± 0.07 mg/g respectively. At the same time, dried coconut sprout flour exhibited the lowest IC_{50} value of 96.87 ± 0.15 mg/g, indicating superior superoxide radical scavenging efficiency compared with fresh sprout, which showed an IC_{50} value of 165.30 ± 0.10 mg/g, and the control 170.98 ± 0.15 mg/g. Lower IC_{50} values correspond to stronger free radical neutralization capacity, a relationship emphasized in standardized antioxidant assessment frameworks[38,39]. The results clearly demonstrated that drying significantly enhances the superoxide radical scavenging potential of coconut sprouts. Dried coconut sprout flour exhibits superior antioxidant efficiency and stability, highlighting its potential application as a functional ingredient in antioxidant-rich foods and nutraceutical formulations, consistent with recent antioxidant research trends reported[34,40,41].

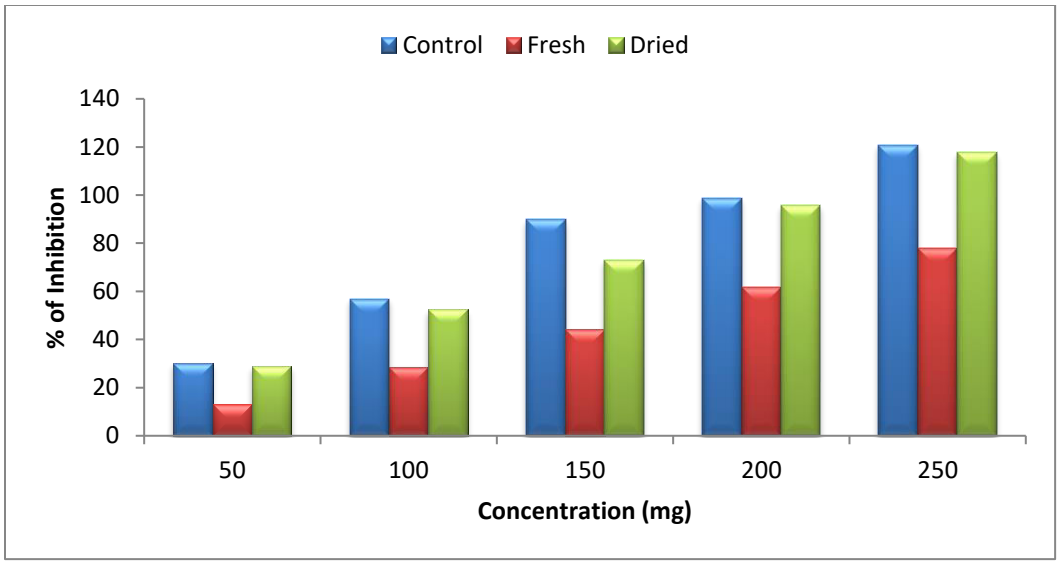

Figure 3 Superoxide radical scavenging activity

Hydroxyl Radical Scavenging activity of Fresh and Dried C.nucifera sprout flour

The evaluation of the hydroxyl radical scavenging activity shown in figure 4 revealed a strong concentration-dependent increase in antioxidant capacity for the standard ascorbic acid, fresh coconut sprout, and dried coconut sprout flour across concentrations ranging from 50 to 250 mg, with statistically significant differences among the samples at $p < 0.001$. The results of inhibition of scavenging free radicals of fresh coconut sprout ranges from 12.50 ± 0.10 to 75.20 ± 0.10 mg/g, the dried coconut sprout flour ranges from 27.50 ± 0.10 mg/g to 115.00 ± 1.00 mg/g, whereas the standard ascorbic acid ranges from 30.75 ± 0.15 mg/g to 130.80 ± 0.15 mg/g respectively.Dried coconut sprout flour exhibited a lower IC_{50} value of 100.47 ± 0.21 mg/g compared to fresh sprout at 170.77 ± 0.06 mg/g, indicating superior hydroxyl radical scavenging efficiency. The reference standard showed an IC_{50} value of 95.55 ± 0.06 mg/g. The enhanced hydroxyl radical scavenging activity of dried coconut sprout flour may be attributed to the concentration and stabilization of phenolic compounds during drying, improved extractability of bound antioxidants, and reduced enzymatic degradation of bioactive constituents. Similar effects of drying on antioxidant enhancement in plant-derived foods[34,42]. In contrast, the comparatively lower activity of fresh coconut sprout may be associated with its high moisture content and the presence of active oxidative enzymes that accelerate phenolic degradation[43].

These results clearly demonstrate that drying significantly improves the hydroxyl radical scavenging potential of coconut sprouts. Dried coconut sprout flour therefore represents a more potent and stable antioxidant ingredient, supporting its potential application in functional foods and nutraceutical formulations, in line with recent

findings on processing-induced enhancement of phenolic-mediated antioxidant activity[42,44].

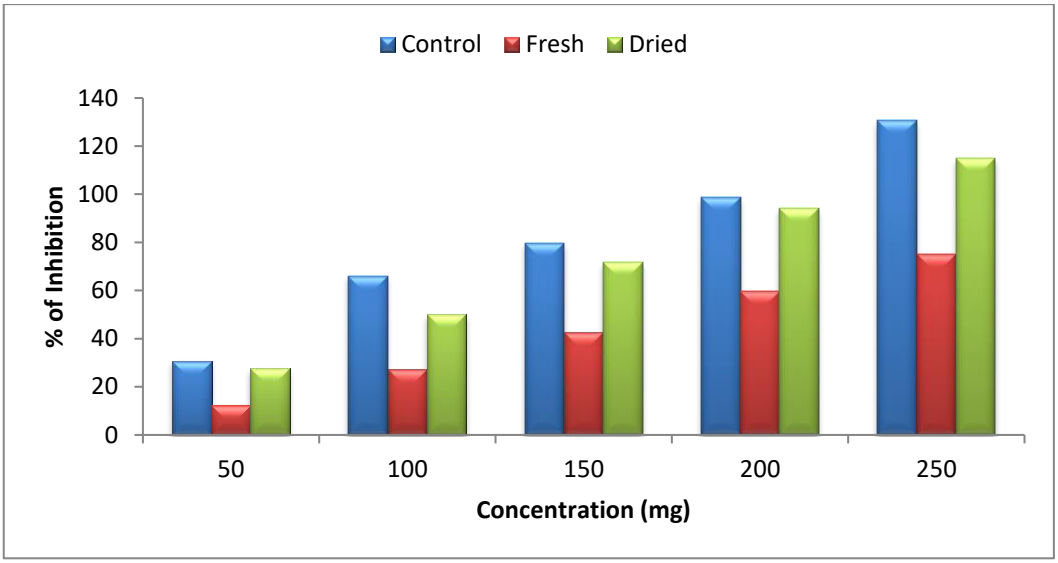

Figure 4 Hydroxyl radical scavenging activity

Hydrogen Peroxide Radical Scavenging activity of Fresh and Dried C.nucifera sprout flour

Figure 5 shows the hydrogen peroxide radical scavenging activity, indicated a pronounced concentration-dependent increase in antioxidant potential for the standard ascorbic acid, fresh and dried coconut sprout flour over the concentration range of 50 to 250 mg, with statistically significant variation among the samples at $p < 0.001$. The inhibition of fresh coconut sprout ranges from 12.10 ±0.10 mg/g to 74.73 ± 0.15 mg/g, the dried coconut sprout flour values possess from 27.1 ± 0.12 mg/g to 114.6 ± 0.21 mg/g, whereas the standard ascorbic acid exhibits form 35.17 ± 0.15 mg/g to 124.9 ± 0.10 mg/g from the concentration ranges from 50 to 250 mg/g respectively. Moreover, thedried coconut sprout flour demonstrated a lower IC_{50} value of 101.40 ± 0.19 mg/g, indicating superior hydrogen peroxide scavenging efficiency compared with fresh sprout, which exhibited an IC_{50} value of 172.97 ± 0.31 mg/g. The reference control showed an IC_{50} value of 95.78 ± 0.25 mg/g. Lower IC_{50} values correspond to stronger in vitro antioxidant potency and are widely employed for comparative antioxidant assessment[45,46].

The results clearly demonstrated that drying significantly enhances the hydrogen peroxide radical scavenging capacity of coconut sprouts. Dried C.nucifera sprout flour therefore emerges as a more potent and stable antioxidant ingredient, supporting its potential utilization in functional food and nutraceutical formulations. These observations are in agreement with recent mechanistic and applied research on phenolic-

mediated hydrogen peroxide neutralization and the influence of processing on antioxidant profiles[42,46].

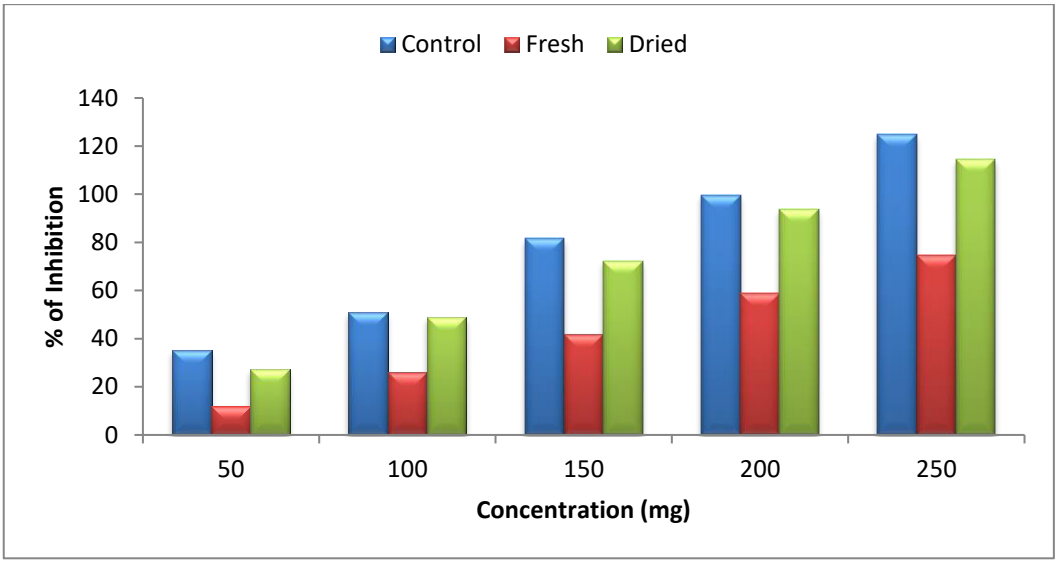

Figure 5Hydrogen Peroxide radical scavenging activity

ABTS⁺ Scavenging activity of Fresh and Dried C.nucifera sprout flour

The evaluation of ABTS⁺ radical scavenging activity presented in figure 6 revealed a pronounced concentration-dependent increase in antioxidant capacity for the standard ascorbic acid, fresh and dried coconut sprout flour across the tested concentration range of 50 to 250 mg, with statistically significant differences among samples at $p < 0.001$. The ABTS⁺ assay is widely employed to assess both hydrophilic and lipophilic antioxidant potential and reflects the capacity of bioactive compounds to donate electrons or hydrogen atoms to neutralize the ABTS radical cation[34,38]. The inhibition values of fresh coconut sprout ranges from 12.7 ± 0.10 mg/g to 76.20 ± 0.20 mg/g, the dried coconut sprout flour possess inhibition from 28.4 ± 0.14 mg/g to 121.0 ± 0.18 mg/g and the standard ascorbic acid ranges from 32.9 ± 0.15 mg/g to 130.50 ± 0.28 mg/g respectively.The dried sample exhibited a lower IC_{50} value of 96.0 ± 0.17 mg/g, indicating stronger ABTS⁺ radical scavenging capacity than fresh sprout, which showed an IC_{50} value of 168.63 ± 0.15 mg/g. The standard ascorbic acid demonstrated the lowest IC_{50} value of 75.70 ± 0.10 mg/g. Lower IC_{50} values are indicative of greater antioxidant potency, as emphasized in standardized antioxidant evaluation systems[38,39].The results clearly noted that drying significantly enhances the ABTS⁺ radical scavenging potential of coconut sprouts. Dried coconut sprout flour therefore represents a more potent and stable antioxidant ingredient, supporting its application in functional foods and nutraceutical formulations, in agreement with contemporary antioxidant research[34,38,43].

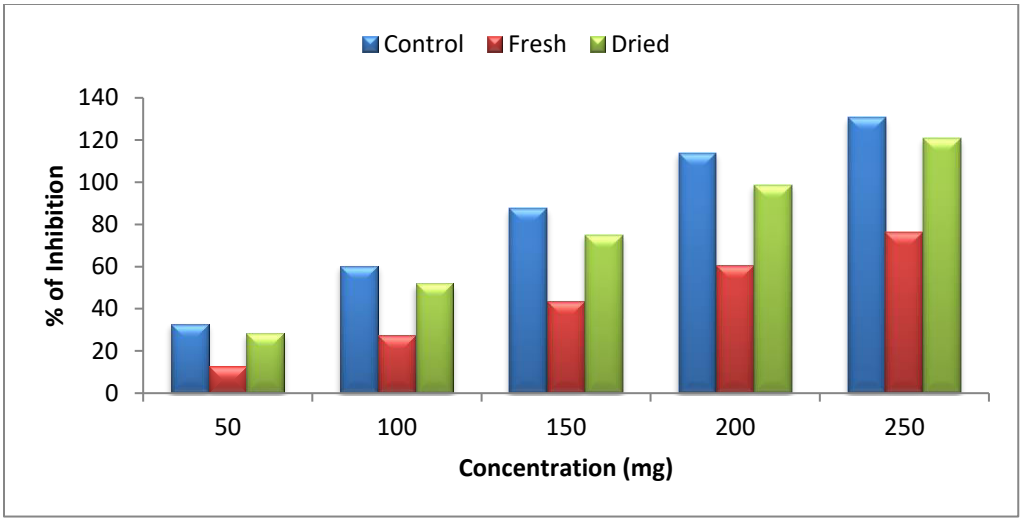

Figure 6 ABTS^{+}radical scavenging activity

Antibacterial activity of Fresh and Dried C.nucifera sprout flour

The antibacterial activities of fresh and dried C.nucifera sprouts against the microflora and its effect werestudied by the zone of inhibition and the values are given in table III.The results of disc diffusion test indicated that fresh and dried flow of C.nucifera sprouts indicates different zone of inhibition depends on the strains of bacteria. The fresh and dried C.nucifera sprouts exhibit the effective antibacterial activity by inhibition growth of bacterial strains such as E.coli and Staphylococcus.

Table III: Antibacterial activity of fresh and dried C. nucifera sprout flour

S.No.	Organism	Zone of Inhibition against	
		Fresh C.nucifera sprout	Dried C.nucifera sprout flour
1.	E.coli	6.0±1.73	10.0±2.64
2.	Staphylococcus	6.0±0.84	8.0±0.58

The antibacterial effect against the strains of E.coli and Staphylococcus of fresh and dried C.nucifera sprouts was 6.0±1.73 and 6.0±0.84 mm and 10.0±2.64 and 8.0±0.58 mm respectively. The results enhanced antibacterial efficiency even at lower concentration following drying.

a. Determination of MIC and MBC of fresh and dried C.nucifera sprouts (against food borne pathogens)

The Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of fresh and dried C.nucifera sprouts against E.coli and Staphylococcus species is mentioneed in table IV.

Table IV: MIC and MBC of Fresh and Dried C.nucifera sprouts against food borne pathogens

S.No.	Organisms	Concentration (mg/g)	MIC and MBC values (mm/g)					
			Fresh C.nucifera sprout			Dried C.nucifera sprout flour		
			Initial MIC (mg/g)	Final MIC (mg/g)	MBC	Initial MIC (mg/g)	Final MIC (mg/g)	MBC
1.	E.coli	100	6.0±0.04	10.0±0.6	6.0±1.02	10.0±0.01	17.0±1.02	10±1.02
2.	Staphylococcus	150	8.0±0.02	12.0±0.24	8.0±1.08	6.0±0.58	16±1.09	6.0±0.08

The result indicates the fresh C.nucifera had reduced activity MIC against E.coli and Staphylococcus (Table IV). The growth inhibition was identified using fresh C.nucifera at concentration of 50 mg/g to 150 mg/g. The growth of E.coli was inhibited at the concentration of 150 mg showed as 6.0±0.04 and at the end at 10.0±0.6 mg/g. The final MIC value of dried C.nucifera sprouts against E.coli at the concentration of 100 mg exhibit 10.0±0.01 mg/g and at the end was 17.0±1.02 mg/g. Moreover, the initial and final growth obstruction of Staphylococcus was 8.0±0.02 mg and 12.0±0.24 mg for fresh C.nucifera sprouts and 6.0±0.58 mg and 16±1.09 mg for dried C.nucifera sprouts respectively. The current researchindicates that, Minimum Bactericidal Concentration of fresh and dried C.nucifera sprouts against E.coli and Staphylococcus was same as MIC value ie. 6.0±1.02 & 10.0±1.02 and 8.0±0.58 & 6.0±0.08 respectively.The superior performance of the dried sample can be attributed to the concentration of phenolic acids and flavonoids during moisture removal which enhance their interaction in its bacterial cell membranes and intracellular targets[47,48].

Enzyme inhibitory Activity of Fresh and Dried C.nucifera sprout

a.α-amylase inhibitory activity of Fresh and Dried C.nucifera sprout

The inhibition of α-amylase enzyme activity of fresh and dried C.nucifera sprout flour is showed in figure 8. The α-Amylase plays a crucial role in the digestion of dietary starch into glucose, and its inhibition is widely recognized as an effective nutritional strategy for moderating postprandial hyperglycemia and managing type 2 diabetes[49].The results stated that the fresh and dried C.nucifera flour inhibited α-amylase enzyme activities in a proportional to the dose, the results of fresh C.nucifera was noted to be from 9.47± 0.06 to 189.73±0.12 percent with the concentration of 50 to 250 mg/g

respectively. Moreover, the dried C.nucifera sprout flour was observed to be from 9.0±0.09 to 69.0±0.22 in the concentration of 50 to 250 mg/g respectively.The IC_{50} of fresh and dried C.nucifera sprouts was noted to be 189.73±0.12 and 187.3±0.27 mg/g respectively.The close similarity between fresh and dried sprouted samples at these concentrations suggests that sprouting enhances the formation of α-amylase inhibitory compounds such as phenolic acids, flavonoids, and low-molecular-weight bioactive peptide[50]. These findings support the potential application of dried coconut sprout flour as a functional ingredient for glycemic regulation and dietary management of type 2 diabetes[50,51].

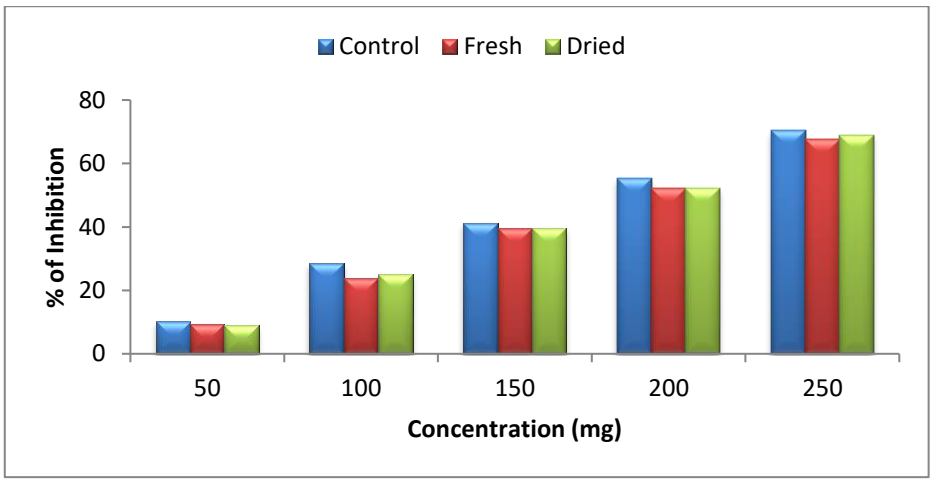

Figure 8α-amylase inhibitory activity

b. Alpha - Glucosidase Inhibition activity of Fresh and Dried C.nucifera sprout flour

The α-glucosidase inhibitory activity of the standard ascorbic acid, fresh and dried sprout coconut flour showed in figure 9 exhibited a distinct concentration-dependent increase across the tested range of 50–250 mg, with statistically significant differences among treatments ($p < 0.001$). The α-Glucosidase is a key intestinal enzyme responsible for the final step of carbohydrate digestion, and its inhibition delays glucose release and absorption, thereby contributing to improved postprandial glycemic control[52].The inhibitory effect of α-glucosidase of fresh and dried C.nucifera sprout noted from 10.80±0.10 to 69.17±0.15 and 9.2±0.13 to 70.8±0.21 mg/g respectively were studied at concentrations between 50 to 250 percent mg/ml. The $IC_{50}$of fresh and dried flour of C.nucifera sprouts was noted that 18.357±0.15 and 182.4±0.32 mg/g.Lower IC_{50} values indicate stronger inhibitory potency, confirming the marginally superior α-glucosidase inhibitory efficiency of dried sprout flour.These findings support the potential application

of dried coconut sprout flour as a functional food ingredient for the dietary management of type 2 diabetes and postprandial hyperglycemia[50,51].

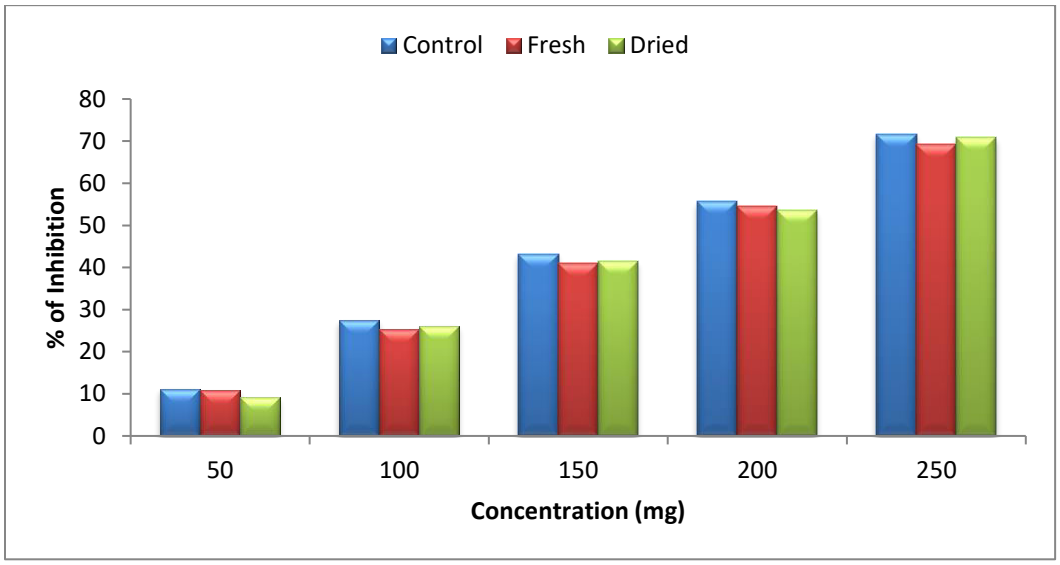

Figure 9 Alpha - Glucosidase inhibitory activity

Anti-inflammatory activity of Fresh and Dried C.nucifera sprout flour

From figure 10, the inhibition of thermally-induced protein (albumin) denaturation in proportional to the dose. The anti-inflammatory potential of fresh and dried C.nucifera sprouts is determined, fresh coconut sprouts showed percent maximum inhibition of 8.10±0.10 to 62.80± 0.10 at concentration of 50 mg to 250 mg with IC_{50} of 206.27±0.06 mg/g. Furthermore, the dried C.nucifera sprouts, showed percent maximum inhibition from 23.03±0.06 to 101+1.00 mg at a concentration of 50 mg to 250 mg with IC_{50} value of 118.97±0.36 mg/g. During protein denaturation, protein loses their structure either by application of strong acid or base, or an inorganic salt, or any heat processing. Protein denaturation is the well-defined causes of any kind of inflammation[53].Hence, the coconut sprouts either in the form of fresh or dried may be ensured strong natural anti-inflammatory agent on account of powerful phytoconstituents such as terpenoids, flavonoids and alkaloids.

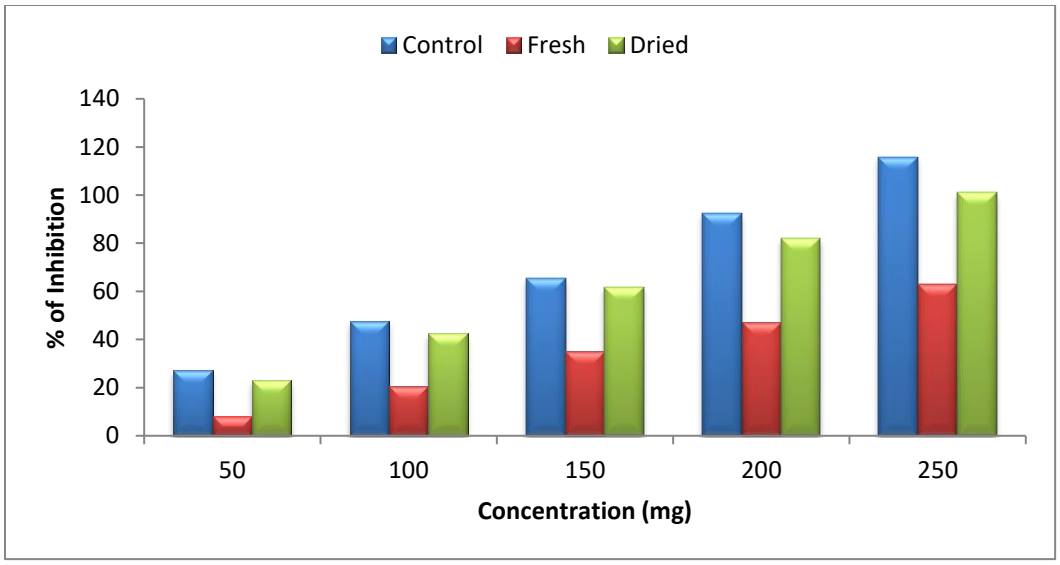

Figure 10 Anti-inflammatory activity

Conclusion

The current researchhighlighted that the fresh and dried C.nucifera sprouts improved with phytochemicals such as phenolic compounds, flavonoids, alkaloids and glucosides which shows potential antioxidant, antibacterial, anti-inflammatory and enzyme inhibitory activity and also used for various disease prevention and health promotion. Moreover, the fresh and dried sprouts are believed to have a stronger anti-inflammatory property which shows to heal the inflammation and defense against food pathogens. The naturally available fresh sprouts are nutrient dense and economically easier to procure for human consumption. Furthermore, developing value-added products either fresh or dried sprouts is an effective way to stimulate consumption.

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