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Wild edible macrofungi of dry deciduous and moist deciduous forests of western Odisha, toxicity: causes and Indian cooking systems, an efficient method to maintain good health.

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Abstract: Tribals and forest dwellers in Odisha are bestowed with various kinds of non-timber forest products (NTFP). Most of these NTFPs include medicinal and dietary need-based forest products. Wild edible mushrooms are a group of such products which have culinary, therapeutic, and commercial values but are underrated. Forests of Western Odisha are mostly dry deciduous and moist deciduous in nature best suitable environment for the availability of fungi, general and macro fungi in particular. Identification and biochemical properties of wild mushrooms of western Odisha are not properly estimated, leading to casualties in some or different parts of this area. Sometimes, the cooking ingredients also make a difference in the toxicity level. Therefore, this attempt has been made to estimate pH, which is an indicator of food quality under different cooking conditions in 13 wild mushrooms found in western Odisha, which are either consumed or sold in markets. Results show that raw mushrooms cooked for a longer time reduce pH and make the dish acidic, but the addition of spices and condiments increases the pH and makes the food healthier by making it neutral or less acidic.

Keywords: Macro fungi, mushroom, western Odisha, tribal food, Toxicity.

I. INTRODUCTION

The edible part of mushrooms is the fruiting body of the macrofungi, which are non-chlorophyllous plants unable to synthesise their own food and instead rely on dead and decayed organic matter. Their role is crucial as ecological decomposers, mutualists, and pathogens; they grow in almost all habitats and provide an important source of food, medicinal agents, livelihoods, and help maintain forest health (Martins, 2016). Mushrooms grow on organic materials like paddy straw, dead wood, manure, and sometimes animal excreta (Rahi & Malik, 2016). According to the Japanese Society of Mycology, there are about 15 lakh fungi in the world. The Indian subcontinent is blessed with favourable agro-climatic conditions suitable for various fungal species. In India, approximately 27,500 species of fungi are found, either wild or cultivated, of which only about 5% are considered edible and are consumed by tribals and forest dwellers. Researchers estimate that there are more than 2,000 species of wild edible mushrooms worldwide, while in India, about 283 edible wild species have been recorded. (Choudhary *et al.,* 2015).

Mushrooms are not only diverse and widely cultivated but also highly nutritious, offering proteins, vitamins, minerals, and antioxidants. Their protein content surpasses most plant and even animal foods, while remaining cholesterol-free. Affordable and versatile, they serve as a sustainable alternative to costly animal proteins. Thus, mushrooms hold both nutritional and economic significance in today's diet.

The restricted use of synthetic antioxidants like BHA (Butylated Hydroxyanisole) and BHT (Butylated Hydroxytoluene) in the food industry has shifted attention towards natural alternatives, with mushrooms emerging as a promising source. They are valued for their antioxidant properties, which help combat oxidative stress through dietary intake. Nutritionally, edible mushrooms are rich in carbohydrates, proteins, vitamins, and minerals, making them significant as both healthy and functional foods. Beyond basic nutrition, many mushrooms provide bioactive compounds with medicinal benefits. For example, *Ganoderma lucidum* contains triterpenoids with anti-carcinogenic potential, while polyunsaturated and monounsaturated fatty acids in species like *Coprinus comatus*, *Ganoderma lucidum*, and *Agaricus bisporus* show anti-diabetic effects by improving insulin sensitivity. Additionally, their high mannitol content and low glycemic index make them particularly beneficial for diabetic patients.

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Fig.1. Global map that represents the different edible mushroom species grown commercially all over the world (Kozarski et al. 2015).

Nutritional values also vary across different parts of the mushroom. In Pleurotus ostreatus (oyster mushroom), the stalk contains the most moisture, whereas the cap has higher protein content. When combined, the cap and stalk exhibit increased crude fibre levels (Oluwafemi et al., 2016). Beyond their nutritional roles, mushrooms are sometimes added to food products as thickeners and flavour enhancers. According to Agrahar-murugkar and Subbulakshmi (2005), macronutrients in seven wild edible mushrooms from Meghalaya were found to be rich in protein, minerals (including trace minerals), and low in fat. It was observed that the vitamin C content (mg/g) in Calvatia gigantea, Cantharellus cibarius, Coprinopsis cinerea, Gomphus occidentalis, Lactarius quieticolor, Ramaria brevispora, and Russula integra were 14.9, 41.9, 41.8, 25.8, 18.1, 28.0, and 19.6 mg/g respectively. Furthermore, Singdevsachan et al. (2013) analysed the vitamin contents (ascorbic acid, riboflavin, and thiamine) in Lentinus sajor-caju and Lentinus torulosus from Odisha, reporting that the highest and lowest thiamine contents were found in Lentinus torulosus (0.19 mg/g) and Lentinus sajor-caju (0.13 mg/g), respectively. Additionally, higher levels of ascorbic acid were found in L. torulosus (52.91 mg/g), with the lowest in the other.

Mushrooms are valued not only for nutrition but also as “mycoremediation tools,” capable of removing pollutants (Kulshreshtha et al., 2014). Their fruiting bodies are rich in essential minerals such as calcium, magnesium, potassium, and phosphorus, along with trace elements like iron, zinc, and copper (Bano et al., 1981; Bano & Rajarathanum, 1982). Wild mushrooms typically contain higher mineral levels than cultivated ones, with species like *Morchella esculenta* noted for their abundance of phosphorus, potassium, calcium, and iron (Kaul, 1978).

Researchers have documented around 1,200 mushroom species in India, of which about 300 are edible (Panda et al., 2019). A study by Meena et al. (2020) identified 132 species across 60 genera, with families like Ganodermataceae, Agaricaceae, and Polyporaceae showing high diversity, while groups such as Auriculariaceae and Tremellaceae were less represented. Among these, the Agaricaceae family, especially the genus *Agaricus*, is widely reported across different Indian states.

Findings showed that most mushrooms appear between June and September. Tribal women and children commonly gather and sell them in local markets, making mushrooms a seasonal livelihood resource. The researchers also prepared dishes from the collected samples. Prior studies in Odisha remain limited—for instance, Panda et al. (2018) recorded only 14 edible species from 5 families.

The consumption of toxic wild mushrooms due to lack of knowledge on their identification and cooking process is a serious public health concern across many parts of the world, including India. Several mushroom species closely resemble edible varieties, making it difficult for rural and tribal communities to distinguish between safe and poisonous types. Accidental ingestion often leads to mushroom poisoning, which can result in mild gastrointestinal discomfort to severe organ failure and even death. Many toxic species mimic edible mushrooms in size, shape, and color, making them difficult to identify without expertise.

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Communities relying on traditional knowledge sometimes mistake unfamiliar species for safe ones. Common mushroom toxins such as *amatoxins*, *phallotoxins*, and *orellanine* can damage the liver, kidneys, and central nervous system.

Sporadic cases have been reported from states such as Odisha, Chhattisgarh, and the North-Eastern region, where tribal populations widely consume wild mushrooms. Lack of immediate medical care in rural areas increases mortality risk. While wild mushrooms provide nutrition and income, toxic varieties pose life-threatening risks. A balance between traditional use and modern scientific guidance is essential to prevent casualties.

As pH is a good indicator of prepared food regarding its health benefits, this study was conducted to understand the pH of 13 wild and marketed mushrooms from Sambalpur and its adjoining areas.

II. METHODOLOGY

A collection drive was conducted in the rainy months of June to September 2024. 13 wild edible and marketed mushroom species were collected. Some of the samples were dried and powdered, whereas other samples were used fresh for cooking purposes. Specimens collected from distant places were dried and powdered, whereas the samples collected from Sambalpur were tested fresh.

The powdered sampleas and fresh samples were soaked in water for an hour. After one hour pH was measured using a single probe digital pH meter. Then these soaked materials were cooked for 10 minutes, 20 minutes and 30 minutes above high flame of kitchen LPG gas stove.

Similarly as per Indian cooking system another set of samples soaked for same time and cooked along with salt, other spices, condiments and oils as desired to taste and pH was measured analogically after 10 minutes, 20 minutes and 30 minutes above high flame of kitchen LPG gas stove.

III. RESULTS AND DISCUSSION

The pH of samples ranged from 6.0 to 7.5. the detailed data is entered in a table. The pH in all cases remained under 7 inferring that the mushroom in general have acidic nature because of the presense of proteins, phenolics, etc. in their cell wall.

Table 1: List of wild edible and marketed mushrooms of Odisha

Local name	Scientific name	Place of Collection
Lal Chati	*Amanita caesarea*	*Naktideul*
Baunsa Chati	*Amanita egregia*	*Bileimunda*
Rugda Chati	*Astraeus hygrometricus*	*Sambalpur and Sundargarh*
Katha Chati	*Cantharellus cibarius*	*Sambalpur*
Shikar Chati	*Dacryopinax spathularia*	*Sambalpur*
Boda Chati	*Macrolepiota procera*	*Naktideul*
Patar Chati	*Russula brevipes*	*Bileimunda*
Patar Chati	*Amanita delica*	*Sambalpur and Sundargarh*
Patar Chati	*Amanita rosea*	*Sundargarh*
Patar Chati	*Russula violeipes*	*Sundargarh*
Bada bali Chati	*Termitomyces clypeatus*	*Sambalpur*
Bali Chati	*Termitomyces microcarpus*	*Naktideul*
Pual Chati	*Volvariella volvacea*	*Bileimunda*

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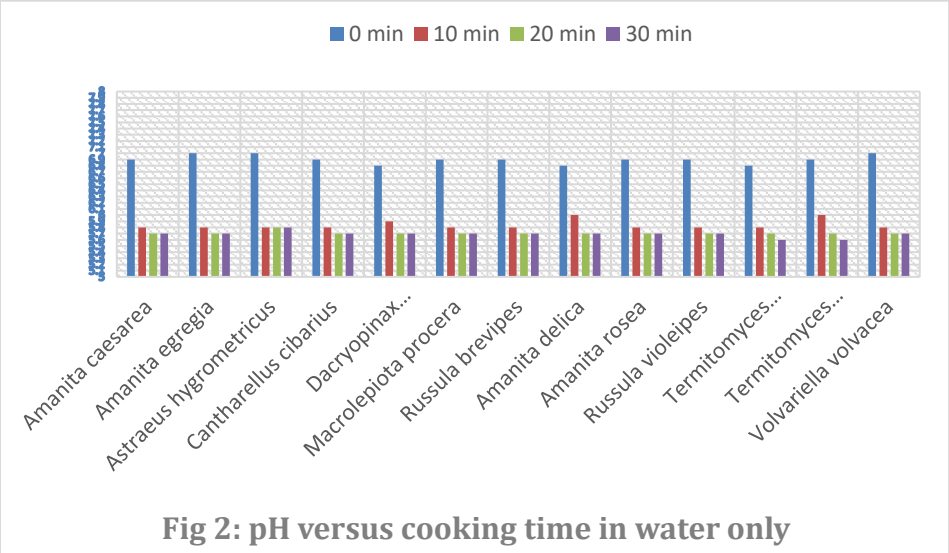

Fig 2: pH versus cooking time in water only

When salt, spices, condiments and oils which are the common food ingredients and speciality of Indian food, were added and cooked the pH reduces and makes the food more acidic. Although the acity is not much high, still it's a concern for health concious population. The acidity further increases as cooking time increases indicating that, cooking time is also of considerable importance in determination of quality of food for good health.

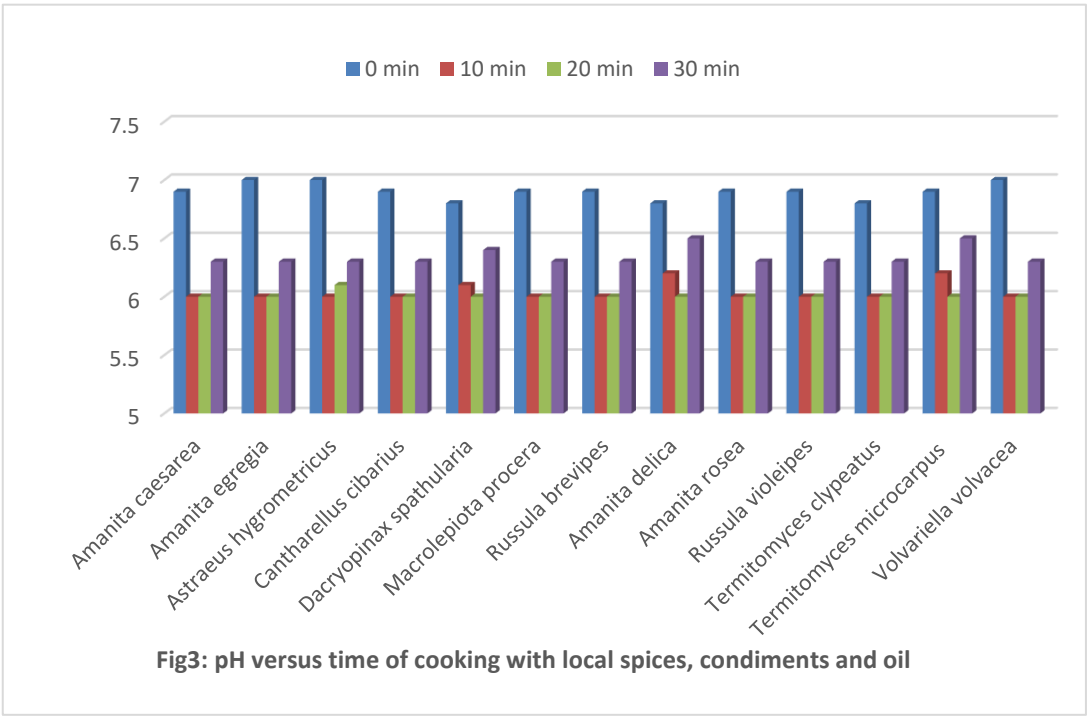

Fig3: pH versus time of cooking with local spices, condiments and oil

Fig 4: Some marketed Mushrooms from the markets of Sambalpur, Odisha

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IV. CONCLUSION

Wild edible mushrooms constitute a critical nutritional and livelihood resource for rural and tribal populations. Nevertheless, declining forest resources and shifts in dietary practices are leading to reduced utilisation, particularly among younger generations who are distancing themselves from traditional food systems. This study underscores the dual role of wild mushrooms as dietary supplements and medicinal resources, highlighting the need for value addition initiatives through government and non-governmental support. Furthermore, comprehensive biochemical and pharmacological analyses are warranted to unlock their full potential.

While consuming any wild mushroom the cooking time and additive spices, salt quantity, condiments and oils play an important role in determining the toxicity level. Casualty reported in some parts of the state in general and western Odisha in particular, needs a thorough knowledge of cooking time and other ingredients to be added. Avoiding ingredients like vegetables which contain acids like citric acid or acetic acid should be avoided or quantitatively reduced along with moderate cooking time to reduce the acidic level of the food prepared.

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