

## Short Communication

## Minerals and trace elements in domesticated Namibian *Ganoderma* species

F. N. Mhanda<sup>1\*</sup>, N. P. Kadhila-Muandingi<sup>2</sup> and I. S. E. Ueitele<sup>1</sup>

<sup>1</sup>Zero Emission Research Initiative (ZERI) University of Namibia.

<sup>2</sup>Department of Biological Sciences, Faculty of Science, University of Namibia.

Received 18 March, 2015; Accepted 13 August, 2015

Edible and medicinal mushrooms are regarded as the ideal health foods. They are well appreciated for their exquisite taste and flavor and are consumed both fresh and in processed forms. Nutritive value of mushrooms is attributed to their high content of essential amino acids, vitamins, minerals and low lipid content. Regular consumption of whole medicinal and edible mushrooms could introduce a functional or medicinal contribution within the individual's diet. Medicinal mushrooms may prevent or treat "lifestyle-related diseases". The extent of the health beneficial effect will depend on the level, regularity of consumption, the relevance of medicinal mushrooms and concentrates to the particular disease. The minerals and trace elements in domesticated Namibian *Ganoderma* mushroom species were determined. The results show that fiber content was found highest with 45 g/100 g of dry weight, followed by calcium with 23 g/100 g, carbohydrate with 23 g/100 g, protein with 18.2 g/100 g, iron with 6.41 g/100 g, copper with 4.3 g/100 g while the least were zinc (2.89 g/100 g) and fat (1.9 g/100 g). The presence of these essential nutrients, which are nutritional requirements of human beings, implies that *Ganoderma* can be a valuable dietary supplement to boost the immune system and improve general health of people. It was therefore concluded that the domesticated *Ganoderma* has significant amount of nutrients that makes it a good fungus to be used on daily bases for health benefit.

**Key words:** Mushrooms, *Ganoderma*, minerals, nutritional, domesticated.

### INTRODUCTION

Edible and medicinal mushrooms are regarded as the ideal health foods. They are well appreciated for their exquisite taste and flavor and are consumed both in the fresh and processed forms (Khurshidul et al., 2009). Nutritive value of mushrooms is attributed to their high content of essential amino acids, vitamins, minerals and low lipid content. Mushroom can be epigeous or hypogeous, large enough to be seen with the naked eyes

and can be picked by hand (Chang and Miles, 1992). *Ganoderma* mushroom commonly known as Ling Zhi in Chinese is an herbal mushroom known to have miraculous health benefits. In China and Japan, *Ganoderma* mushrooms are cultivated and utilized as useful source of feed supplement, medicine for promoting health and immune functions in humans, and for prevention and treatment of various diseases (Jong and

\*Corresponding author. E-mail: fmhanda@unam.na.

Birmingham, 1992; Oei, 2003; Wachtel-Galor et al., 2004). These mushrooms are utilized as dried whole, powder or capsules and as tablets for promoting health in humans (Oei, 2003). It is non-toxic and can be taken daily without producing any side effects, Oei (2003) concluded. Mushrooms have rich nutritional value with high protein content (up to 44.93%), vitamins, minerals, fibers, trace elements, low calories, lack cholesterol with many of them being used as food and folk medicine for thousands of years (Thatoi and Singdevsachan, 2014). They further stated that mushrooms are a source of bioactive substances including antibacterial, antifungal, antiviral, antioxidant, anti-inflammatory, anticancer, antitumor, anti-HIV and antidiabetic activities.

In fact, a study published in the Journal of Experimental Oncology said that, *Ganoderma lucidum* extract inhibits proliferation of human colorectal cancer cells and possesses antioxidant properties (Xie et al., 2006). Along those same lines another study came out stating, "the overall findings indicated that Ganopoly had antitumor activities and that it may also have promising immunotherapeutic agent in cancer treatment". In addition, *G. lucidum* has also been used as an anxiety reducer, improvement in sleep, circulation, and brain functions (Gao et al., 2005).

In developing countries like India with rich biodiversity, mushrooms are a boon for progress in the field of food, medicine and unemployment because of several nutraceuticals. Medicinal mushrooms have been found to be useful to human health development as food, medicine, minerals and drugs among others (Rai et al., 2005; Sheena et al., 2005; Wani et al., 2010).

Qualitative and quantitative analysis of wild *G. lucidum* harvested from Vom in Nigeria was carried out by Ogbe (2008) and the analysis indicated that wild *Ganoderma* contained high amounts of crude fibre (34.7%), protein (13.3%), fat (2.6%) and some bioactive compounds like saponins and resins (Ogbe et al., 2009a). These chemical compounds and nutrients play important roles in nutrition, maintaining good health and physiological functions of the body. They promote growth performance and humoral immune response to vaccinations (Ogbe et al., 2008). Trace elements found in most mushrooms are: copper (Cu), zinc (Zn), chromium (Cr), cadmium (Cd), manganese (Mn), iron (Fe), nickel (Ni), and lead (Pb) (Zhu et al., 2010). Minerals in the diet are essential for metabolic reactions, transmission of nerve impulses, firm bone formation, and regulation of water and salt balance (Bradstreet, 1965).

With all the above important attributes of *Ganoderma* mushrooms, there is need to analyze mineral contents of domesticated Namibian medicinal mushrooms (*G. lucidum*) in order to determine if they have the same mineral contents as the wild *G. lucidum*, and whether they contain amount of minerals in the right consumable amount as other species of *Ganoderma* mushroom which has been analyzed. This study analyzed the amount of

**Table 1.** The proximate mineral composition of the domesticated *Ganoderma* mushrooms.

Nutrients analyzed	Composition (g/100 g)
Moisture	9.1
Crude fibre	45
Protein	18.2
Fats and oils	1.9
Nitrogen	2.91
Carbohydrates	23
Ash	2.6
Iron	6.41
Calcium	23.2
Zinc	2.89
Copper	4.30

mineral elements found in domesticated Namibian *Ganoderma* mushrooms, which has not been analyzed and the information will help to determine the consumption daily rate of *G. lucidum* capsules produced at the University of Namibia.

## MATERIALS AND METHODS

Domesticated Namibian *Ganoderma* mushrooms were provided by the Zero Emissions Research Initiative (ZERI) project at the University of Namibia. The samples were first air dried before drying in an oven at 60°C for 30 min and ground into powder. The powder (100 g) was sent to the Analytical Laboratory Services in Windhoek for mineral analysis. Moisture, ash, crude fibre and fat content were determined using the Association of Official Analytical Chemists (AOAC, 1990) methods while the nitrogen was determined using the micro-Kjeldahl process as described by Pearson (1976) from which the crude protein was calculated as % N x 6.25. The carbohydrate content was determined by difference, (Müller and Tobin, 1980) that is 100- (moisture, ash, crude fibre, fat and crude protein). A factor of 0.8 is used to convert the total fat to fatty acid (to get the fatty acid in the total fat). Calcium, iron, copper and zinc were determined by Official and Standardised methods of Analysis (Watson, 1994).

## RESULTS AND DISCUSSION

Data presented in Table 1 are the exact amount of nutrient contents found for each mineral in grams per 100 g. Mushrooms are generally high in moisture content; in the present analysis of the domesticated *Ganoderma*, the moisture content was found to be 9.1 g/100 g. This is lower than that of some edible mushrooms reported (Ogbe et al., 2005; Ketiku and Ola, 1999; Zakhary et al., 1983). Mushrooms are considered to be a good source of digestible proteins as stated by Ogbe et al. (2013); in present analysis, crude protein content was found to be 18.2 g which seems to be of satisfactory. Mushrooms are

said to contain less fat (Khurshidul et al., 2009). This analysis found the amount being 1.9 g of dry weight. These mushrooms have no cholesterol and are virtually low in fat. All fresh medicinal mushrooms are free of trans fats. The fat content of both edible and medicinal mushrooms consists mostly of unsaturated fatty acids, which are less hazardous to health than saturated fatty acids of animal fats, making it a valuable nutritionally healthy ingredient for human being (Khurshidul et al., 2009). The results show that the fruiting bodies of the domesticated *G. lucidum* are a good source of protein (18.2 g/100 g) and carbohydrates (23 g/100 g). The carbohydrate content of the analyzed mushrooms did not differ much from that reported by Ogbe et al. (2009a). However, the crude fibre (45 g/100 g) was higher than that of the *Ganoderma* species reported (Ogbe et al., 2009a). The ash content (2.6 g/100 g) showed that the domesticated mushroom contained some nutritionally important minerals and can be used in the development of dietary supplement. This analysis found that the contents of moisture, crude protein, total lipids, available carbohydrates, dietary fiber, total ash and calorie were in agreement with the values reported in some previous studies done on *Ganoderma* species (Ogbe et al., 2005; Ketiku and Ola, 1999; Zakhary et al., 1983).

### Conflict of interests

The authors did not declare any conflict of interest.

### REFERENCES

- AOAC (1990). Official Methods of Analysis, 15th ed., Association of Official Chemists. Washington, D.C.
- Bradstreet RB (1965). The Kjeldahl Method for organic Nitrogen. Academic Press, New York 8: 39-88
- Chang ST, Miles PG (1992). Mushroom biology-A new discipline. *Mycologist* 6: 64-65.
- Jong SC, Birmingham JM (1992). Medicinal benefits of the mushroom. *Ganoderma*. *Appl. Microbiol.* 37:101-134.
- Ketiku AO, Ola L (1999). Chemical composition and effects of mushroom (*Lentinus subnudus*) preparations on the lipid profile of rats. *Trop. Anim. Prod.* 2:169-174.
- Khurshidul MZ, Sagarmay B, Imamul HS (2009). Proximate Composition and Mineral Content of Selected Edible Mushroom Varieties of Bangladesh. *Bangladesh J. Nutr.* 30: 22-23.
- Müller HG, Tobin G (1980) Nutrition and food processing. London (UK): Croom Helm.
- Oei P (2003). Mushroom cultivation. In *Appropriate Technology for the Mushroom Growers*; CTA, 3<sup>rd</sup> Ed., Backhuys Publishers, Leiden, The Netherlands. 2:1-7
- Ogbe AO (2008). The use of *Ganoderma lucidum* in improvement of antibody response to infectious bursal disease vaccination and treatment of caecal coccidiosis in chickens. Ph.D Dissertation. Department of Veterinary Surgery and Medicine, Ahmadu Bello University, Zaria, Nigeria. pp. 73-97.
- Ogbe AO, Ditse U, Echeonwu I, Ajodoh K, Atawodi SE, Abdu PA (2009a). Potential of a wild mushroom, *Ganoderma* species as feed supplement in chicken diet: effect on performance and health. *Int. J. Poult. Sci.* 8(11):1052-1057.
- Ogbe AO, Mgbojkwé LO, Owoade AA, Atawodi SE, Abdu PA (2005). The effect of a wild mushroom (*Ganoderma lucidum*) supplementation of feed on the immune response of pullet chickens to infectious bursal disease vaccines. *Elect. J. Environ. Agric. Food Chem.* 7(4): 2844-2855
- Ogbe AO, Obeka, AD (2013). Proximate, mineral and anti-nutrient composition of wild *Ganoderma lucidum*: Implication on its utilization in poultry production. *Iran. J. Appl. Anim. Sci.* 3(1):161-166.
- Pearson D (1976). *Chemical Analysis of Foods*, 7th ed. Churchill, Livingstone, London.
- Rai M, Tidke G, Wasser SP (2005). Therapeutic potential of mushrooms. *Nat. Prod. Rad.* 4(4):246-257
- Thatoi H, Singdevsacham (2014). Medicinal nutritional composition and medicinal potential of Indian mushroom: A review. *Academic Journals India.* 13(4):524-545.
- Wachtel-Galor S, Tomlinson B, Benzie IFF (2004). *Ganoderma lucidum* („Lingzhi“), a Chinese medicinal mushroom: biomarker responses in a controlled human supplementation study. *Br. J. Nutr.* 21(2):287-289.
- Wani AB, Bodha RH, Wani AH (2010). Nutritional and Medicinal importance of mushrooms. University of Kashmir, India. *J. Med. Plant Res.* 4(24): 2598-2604.
- Watson C (1994) *Official and standardized methods of analysis*, Royal Society of Chemistry, Cambridge.
- Xie JT, Wang CZ, Wicks S, Yin JJ, Kong J, Li J, Li YC, Yuan SC (2006) *Ganoderma lucidum* extract inhibits proliferation of SW 480 human colorectal cancer cells. *Exp. Oncol.* 28(1):25-29.
- Zakhary JW, Taiseer M, Abo-Bakr A, EL-Mahdy A, Tabey SA (1983). Chemical composition of wild mushrooms collected from Alexandria, Egypt. *Food Chem.* 11:31-41.
- Zhu F, Qu L, Fan W, Qiao M, Hao H, Wang X (2010). Assessment of heavy metals in some wild edible mushrooms collected from Yunnan Province, China. *Environ. Monit. Assess.* 179: 1- 4.