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A Review on *Polyporus Spp*. (Ghariqun), with Ibn Rushd Perspective and Modern Phytochemistry and Pharmacology

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ABSTRACT

This is a specific review of Ghariqun (Agharicon), *Polyporus* species, *P. officinalis*; *P. fomentarius*; *P. ignarius*, focusing in the current ethnopharmacological research confirming the uses mention by Ibn Rushd, such as dissolving and cutting of heavy humours and lightening the slick of the liver, spleen, kidneys and head and it is beneficial to those who have been rattled by a poisonous animal. Polyporus species, non-photosynthetic microorganism, rich in secondary metabolites like triterpenoids, saponins, coumarins, flavonoids, carbohydrate and polysaccharides. Current ethnopharmacological research showed a beneficial effects of Polyporus species in the treatment of liver, brain and glaucoma, but devoid any laxative effect.

Keywords: *Polyporus; officinalis; fomentarius; ignarius; Ghariqon; Ibn Rushd*

INTRODUCTION

The Andalusian philosopher Ibn Rushd (1128 AD - 1198 AD), known in west by the name of Averroes. Ibn Rushd was a faithful disciple of Aristotle and he stuck to the organization of the Aristotelian corpus implemented by Andronicus of Rhodes. He wrote many books in natural physics, philosophy and in addition one book in medicine known as “Kulliyat Fi A-Tibb, known in its Latin translation as Colliget [1,2]. Ibn Rushd wrote a full chapter of using medicinal plants used for treatment of verities of diseases in different dosage forms following Galen in their application [1]. In this review, I will focus on Ghariqun, Ghariqon (Agharicon) uses mentioned by Ibn Rushd and their current application based on scientific researches merit. The Ghariqon (Agharicon) is an important purgative fungus, used in Unani System of Medicine since ancient Greece period, and it was said that the Ghariqun was named in relation to the land of the Greeks because it grows on certain Greek trees which is a wood-rotting fungus that grows on different hosts such as conifers, most of polypores live on the substrate of fallen trunks and rotten wood. The mushroom is native to Europe, Asia, and North America [2-4]. The genus is named *Polyporus* (Gr. Poly meaning many; poros meaning pores) because of the presence of numerous fine pores on the under-surface of the fruit bodies. Members of the family *Polyporaceae* are commonly called pore fungi and the outer margin of the fruit body looks like first brackets and thus called bracket fungi [2].The white agaric *Polyporus officinalis*

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(Vill.) Fr. synonym for *Fomitopsis officinalis* (Vill.) Bondartsev & Singer. *Polyporus officinalis* is also called female agaric or agaric of pharmacists, and it is a mushroom of large size about 40 cm wide, fragile, its conical, round, or horse-like shape is covered in white, scentless, scented scales. It grows on the bark of Melez trees, which are abundant in the temperate regions of West-Europe, North America, Ural-Siberia, and some small populations in Morocco, China, Japan and Korea [5,6]. Oak agaric *Polyporus fomentarius* (L.) Fr. synonym for *Fomes fomentarius* (L.) Fr. *Polyporus fomentarius*, grows on the bark of oak trees. Fomes species, which often cause decay and destruction of wood, often cause white decay on trees. It is also called agaric surgeons agaric, because surgeons make from it the sponge "Amadou" used in surgery to stop the bleeding [5,6]. *Cedar ghariqun*, *Polyporus igniarius* (L.) Fr., synonym for *Phellinus igniarius* (L.) Quél. *Polyporus ignarius*, which grows on the trunks of cedar trees in the countries of the North Africa. The smell is descriptions that apply to what the ancients mentioned to the female agaric, because the female is light white and fragile that is used medically [5,7]. As for the male, it is the opposite of that is very solid and toxic. *Polyporus sp.* categorized as either ascomycetes or basidiomycetes have a reproductive phase (fruiting bodies) and a vegetative phase (mycelia) [8].

MATERIALS AND METHODS

All the available information on Ghariqun was collected from Ibn Rushd book "Kulliyat Fi A-Tibb, Colliget" and via a library and electronic search (using Web of Science, PubMed, SciFinder, Scopus, Google Scholar, etc.).

RESULTS AND DISCUSSION

Uses of *Polyporus sp.* mentioned by Ibn Rushd

Ibn Rushd in his book Kulliyat Fi A-Tibb, (Colliget) mentioned that Ghariqun is found in eroded trees as a mold, and most of them are in the heart of the cedar trees, has a gray color, then he described its medicinal uses "This medicine was not included by Galen, if a person tastes it, he finds sweetness first in it, then after bitterness, then after a pungency with a slight astringency. Because this plant is similar to the shreds on the ground, it is crumbly, fragile with white in color. As for its actions, dissolving and cutting of heavy humours and lightening the slick of the liver, spleen, kidneys and head. As for its properties, it is beneficial to those who have been rattled by a poisonous animal, they claim, if its poison shows symptoms of cold, a drink from it, is of one weight (Mithqal)*. It is also a recommended medicine in diarrhea for heavy humours, without the harm to laxatives. It is in the first rank of the most attractive medicine from the far parts of the body, it has a property in purifying the brain, and therefore it heals from epilepsy, and from the beginning of the water coming down in the eye, the drink from it is from one to two Dirhams**" [1].

*Mithqal equals to one and a half dirham (4.680 g).
**Dirham equal to 3.125 g.

The chemical composition of *Polyporus sp.*

Polyporus spp., non-photosynthetic microorganism that play vital role in the environment in the biodegradation of organic materials, which gave their names to the triterpenoid polyporenic acid, including squalene derivatives, protostanes, lanostanes, holostanes, cycloartanes, dammaranes, euphanes, tirucallanes, tetranortriterpenoids, quassinoids, lupanes, oleananes, friedelanes, ursanes, hopanes, serratanes and saponins [9]. Lanostane triterpenoids have been isolated from *Polyporus spp.* [10]. The fruit bodies of the fungi *P. fomentarius* revealed the presence of polysaccharide content, contains

of α-(1→6)-linked D-galactopyranosyl residues, of which 30% to 40% are substituted in the 2-position by L-fucopyranosyl residues, 3-O-α-D-mannopyranosyl-L-fucopyranosyl residues, or D-galactopyranosyl residues [11]. Other study showed that P. fomentarius contains a backbone of a branched β-D-glucan, in which the D-glucose residues are connected by (1→3)- and (1→6)-linkages [12].

Agaric Acid, or Agariein, "Agaricine", Agaricinio Acid, or Laracio Acid has been officially described in many pharmacopoeias. Agaric Acid or Agaricin 'is now considered the principal active constituent of Agaric [13]. Eburicoic acid, sulfurenic acid, versisponic acid, dehydroeburicoic acid, 3- ketodehydrosulfurenic acid, fomefficinic acid, fomefficinic acid, dehydrosulfurenic acid, fomefficinol, fomlactone, laricinolic acid, agaric acid, fomitopsin, officimalonic acids, fomitopsin, fomitopsin trypanocidal demalonyl fomitopsin h and trypanocidal fomitopsin ethyl ester have been isolated from the mycelium of F. officinalis [7,14-17]. Erythro-2,3- Dihydroxytetracosanoic, -pentacosanoic and -hexacosanoic acids in a 5.4:2.6:1 ratio, were found in the most polar compounds of *P. officinalis* [15,16]. *P. officinalis* (-)-decylcitric acid, agaricic acid (hexadecylcitric acid), caperatic acid [18]. Agaricinic acid was extracted from the carophore of *F. officinalis* [19]. Fatty acid isolated from the fruit bodies of *Polyporus spp.,* the major one was cis-linoleic acid, it is percentage varied from 22.39% to 65.29%. The other major fatty acids were, respectively, cis-oleic, palmitic, and stearic acids. Fatty acids analysis of the mushrooms showed that the unsaturated fatty acids were at higher concentrations than saturated fatty acids [20,21].

Current pharmacology of *Polyporus spp.*

The chemical activities of fungi have long history. Many fungi due to the competitive environment in which they live, produce of varying efficiency antibiotics. Dioscorides described the use of infusion that called agaricium which was obtained from the larch polypore (*P. officinalis*), and was used for the treatment of tuberculosis. The activity is attributed to the presence of agaricic acid or laricic acid (α-cetylcitric acid) [22]. In ancient China and most Asian countries, it was believed that medicinal mushrooms had the power to enhance long life and liveliness [7].

***Polyporus* Species and liver treatment**

One of the most common diseases affecting the liver is Hepatitis C (HCV), it is estimated that 170 million persons worldwide infected and thus represents a viral pandemic, one that is five times as widespread as infection with the human immunodeficiency virus type (HIV-1) [23]. There is evidence of a broad-spectrum antibacterial and antiviral activity by *F. officinalis*, including pathogens like *Mycobacterium tuberculosis*, *Yersinia pseudotuberculosis* and *Staphylococcus aureus*, as well as Ortopox virus. Chlorinated coumarins from mycelia and lanostane triterpenoids from basidiomes have been demonstrated to be directly responsible for antiviral-antibacterial and trypanocidal activity, respectively [24]. *P. officinalis* extract showed various biological effects as anti-viral (especially against smallpox, H5N1 influenza, and hepatitis C virus), anti-tuberculosis, boosting the immune system [2]. It has been proved that both crude extracts and the compounds isolated from F. officinalis, triterpenoids, polysaccharides, organic acids, coumarins and phenolic compounds have a wide spectrum of therapeutic effects, including anti-inflammatory, cytotoxic, and antimicrobial effects [25].

F. officinalis extract was given to mice at low-dose, middle-dose and high-dose group of 100 mg/kg, 200 mg/kg, and 400 mg/kg. The effects of different doses of *F. officinalis* extract on the loaded-swimming time, the content of serum urea nitrogen, the blood lactic acid, the hepatic glycogen and the muscle glycogen after exercise, the survival time under hypoxia

at normal pressure and the maintenance time after decapitation were observed. *F. officinalis* extract has anti-fatigue effects and can improve hypoxia tolerance group [26]. Flavonoids isolated from *F. officinalis* were tested to investigate the cerebral index, spleen index, thymus index, the contents of malondi-aldehyde (MDA) and the activities of glutathione peroxidase (GSH-Px) in brain tissues as well as the activities of catalase (CAT) and superoxide dismutase (SOD) in liver tissues of the aging model mice. Three doses of *F. officinalis* flavonoids given at of 100 mg/kg, 200 mg/kg and 400 mg/(kg/d) for 6 weeks. Three doses of the *F. officinalis* flavonoids could elevate the cerebral index, spleen index, thymus index, activities of GSH-Px in brain tissues, the activities of CAT and SOD in liver tissues to different degree and decrease the contents of MDA. The *F. officinalis* flavonoids might have anti-senile action by improving antioxidant capacity of human body [27]. A common Chinese species, *P. umbellatus* used as hepatoprotective drug. Chinese Food and Drug Administration (SFDA) approved this drug, which have been used alone or in combination with a variety of clinical drugs for treating Hepatitis B, lung and liver cancers in China since 1990 [28]. The hepatoprotective effect of *P. umbellatus* due to the presence of polysachharides [28,29]. Moreover, the combined therapies for *P. umbellatus* plus hepatitis B vaccine, *P. umbellatus* plus interferon, *P. umbellatus* plus acyclovir, and *P. umbellatus* plus iRNA are better than when treated with either drug alone [28-30].

***Polyporus spp.* and brain treatment**

Neurodegenerative diseases such as dementia and Alzheimer's disease will continue to rise steadily, and is expected to reach 42 million cases worldwide in 2020. Edible mushrooms have been shown to contain rare and exotic compounds that exhibit positive effects on brain cells both in vitro and in vivo, these mushrooms may be regarded as functional foods for the mitigation of neurodegenerative diseases [31]. Polyporus decoction taken orally was given to 48 patients suffering from treatment of traumatic brain injury without considering surgery. Results of clinical efficacy of the treatment group significantly better than the control group and treatment of traumatic brain injury results were satisfactory [32]. Significant increments in quantity of heavy metals sequestered by immobilized live mycelia of *P. squamosus* having maximum adsorption for cationic metal ions at pH 4. Results have shown that, for immobilized and plain Ca-alginate, the amounts of K, Ca, Mg, adsorbed were higher than those of the heavy metal ions, Cr, Fe, Pb, Mn, Ni and Cu [33]. I think fruit body of *Polyporus sp.* have the ability to adsorb excess of cationic ions which responsible for certain brain disorders. *F. officinalis* extract showed inhibitory effect on thrombin. The inhibitory rate of the active compound, versisponic acid, on thrombin was 45.36% [28]. Lanostane triterpene isolated from *F. officinalis* showed inhibitory activity against Trypanosoma congolense, which causes fatal diseases in animals including livestock [29].

***Polyporus spp.* and glaucoma treatment**

In Chinese Traditional Medicine (CTM) mentioned that emotional depression of a person may cause stagnation of liver, spleen, phlegm will turn into fire; Besides, deficiency of the liver and kidney, will result in asthenic fire, when the fire goes upward to attack the eyes, the disease occurs (glaucoma). Decoction of a formula containing *Polyporus spp.* was used for the treatment of glaucoma. In n one study 55 patients were receiving tablets contain Herb Formula, including *Polyporus*, the results showed that 63% were treated from open or closed angle glaucoma; other study showed that *Polyporus* powder activating blood, dieresis and improving eyesight is used to treat macular degeneration and drusen of lamina vitrea [34,35].

CONCLUSION

The results give further insights into the pharmacological activity beneficial effects of *Polyporus spp.* in the treatment of liver, brain and glaucoma, but devoid any laxative effect, thus confirming the different uses mentioned by Ibn Rushd.

CONFLICT OF INTEREST

The author has stated that there is no conflict of interest associated with the publication and no financial support, which could have influenced the outcome.

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