

= Handkea utriformis =

Handkea utriformis , synonymous with *Lycoperdon utriforme* , *Lycoperdon caelatum* or *Calvatia utriformis* , is a species of the Lycoperdaceae family of puffballs . A rather large mushroom , it may reach dimensions of up to 25 cm (9 @. @ 8 in) broad by 20 cm (7 @. @ 9 in) tall . It is commonly known as the mosaic puffball , a reference to the polygonal @-@ shaped segments the outer surface of the fruiting body develops as it matures . Widespread in northern temperate zones , it is found frequently on pastures and sandy heaths , and is edible when young . *H. utriformis* has antibiotic activity against a number of bacteria , and can bioaccumulate the trace metals copper and zinc to relatively high concentrations .

= = Taxonomy = =

This puffball was originally described in 1790 by French botanist Jean Baptiste François Pierre Bulliard as *Lycoperdon utriforme* , and since then , has been variously placed in the genera *Bovista* , *Lycoperdon* , *Calvatia* , and *Utraria* . In 1989 , German mycologist Hanns Kreisel described the genus *Handkea* to include species of *Calvatia* that had distinct microscopic features : *Handkea* species have a unique type of capillitium (coarse thick @-@ walled hyphae in the gleba) , with curvy slits instead of the usual pores . Although accepted by some authors , the genus concept has been rejected by others .

In the past , the species (when it was known as *Calvatia utriformis*) has been separated into three varieties (*C. utriformis* var. *utriformis* , *C. utriformis* var. *hungarica* and *C. utriformis* var. *gruberi*) based on differences in the ornamentation of the exoperidium (outer tissue layer of the wall , or peridium) and spores . However , a 1997 study of these characters revealed that the three varieties are not clearly demarcated . This study and others suggest that variations in the environmental conditions in which the specimens are grown can affect the development of these characteristics .

Phylogenetic analyses published in 2008 shows that *Handkea* may be grouped in a clade along with species from several other genera , including *Lycoperdon* , *Vascellum* , *Morganella* , *Bovistella* , and *Calvatia* . Published in the same year , another DNA analysis of the structure of ITS2 rDNA transcript confirmed that *H. utriformis* is closely related to *Lycoperdon echinatum* .

= = Description = =

Like all puffballs , *Handkea utriformis* has a gasteroid basidiocarp , meaning the spores are produced internally , and are only released as the mature fruiting body ages and dries , or is broken .

Young puffballs are typically 6 to 12 centimetres (2 @. @ 4 to 4 @. @ 7 in) across , white , or pale grey @-@ brown ; in maturity it may attain dimensions of 25 centimetres (9 @. @ 8 in) broad by 20 centimetres (7 @. @ 9 in) tall . The exoperidium is tomentose ? desely covered with a layer of fine matted hairs . The species derives its common name " mosaic puffball " from the mosaic pattern across the top and sides that develops as the fruiting body matures and the outer wall (exoperidium) breaks up into polygonal patches . The underside of the puffball is attached to the ground by a root @-@ like assemblage of hyphae called a rhizomorph . It is squat in appearance and roughly pear @-@ shaped , not usually taller than it is wide . The flesh (gleba , or spore bearing mass) is white when young , but becomes brown and powdery upon maturity . The upper skin eventually disintegrates weeks or even months after the puffball 's appearance , and the brown spores are released into the air ; this process is often hastened by rain , or by being trodden on by cattle . Eventually , all that remains is the sterile cup @-@ shaped base , which can sometimes hold water . This feature may have been the source of the specific epithet , as *utrarius* is Latin for ? water carrier ? .

= = = Microscopic features = = =

The spores of *H. utriformis* are roughly spherical , smooth , and thick @-@ walled , with a single oil droplet . They have dimensions of 4 @.@ 5 ? 5 @.@ 5 μm .

= = = Similar species = = =

A number of puffball species resemble *H. utriformis* , including *Calvatia cyathiformis* , *C. booniana* , and *C. pachyderma* . *Calvatia cyathiformis* has a purple @-@ colored gleba with a smooth exoperidium ; *C. booniana* has an exoperidium that resembles felt or has tufts of soft " hairs " like *H. utriformis* but does not have any stem and has a capillitium with rounded rather than sinuous pits ; *C. pachyderma* has an exoperidium that is thicker and smoother than *H. utriformis* .

= = Distribution and habitat = =

Handkea utriformis is widespread , and frequent in northern temperate zones . It is found in Europe , continental Asia , Japan , eastern atlantic North America , Mexico , and South Africa . It has also been collected in Chile , and New Zealand . Growing alone or in small groups , it favors sandy open pastures , or heaths , and is often found in coastal regions . It typically fruits in summer through late autumn (July - November in the UK) .

= = Edibility = =

This fairly large puffball is edible only when the spore bearing flesh is young , and white . It is said to lack texture , and the taste and odor of the young fruiting bodies are described as " not distinctive " . A 2007 study of the fatty acid composition of various edible Lycoperdaceae species determined the lipid content of *H. utriformis* to be quite low , approximately 1 @.@ 8 % (wet weight) . The fatty acid content was largely linoleic acid (42 @.@ 4 %) , oleic acid (23 %) , palmitic acid (12 @.@ 2 %) , and stearic acid (3 @.@ 6 %) ; 17 other fatty acids of various chain lengths and degrees of unsaturation contributed to the total fatty acid composition .

= = Antibiotic activity = =

A 2005 study of the antimicrobial activity of several Lycoperdaceae revealed that *Handkea utriformis* has " significantly active " against a number of bacteria , including *Bacillus subtilis* , *Escherichia coli* , *Klebsiella pneumonia* , *Pseudomonas aeruginosa* , *Salmonella typhimurium* , *Staphylococcus aureus* , *Streptococcus pyogenes* , and *Mycobacterium smegmatis* . On the other hand , *H. utriformis* has low antifungal activity against the species *Candida albicans* , *Rhodotorula rubra* , and *Kluyveromyces fragilis* .

= = Bioaccumulation = =

A study of the copper and zinc concentrations in 28 different species of edible mushroom showed that *H. utriformis* selectively bioaccumulated both copper (251 @.@ 9 mg of copper per kilogram of mushroom) and zinc (282 @.@ 1 mg Zn / kg mushroom) to higher levels than all other mushrooms tested . The authors note that although these trace elements are important nutritional requirements for humans , and that *H. utriformis* may be considered a good source of these elements , it is known that absorption of the elements (bioavailability) from mushrooms is " low due to limited absorption from the small intestine " .