THE ROYAL SUN AGARICUS OR HIMEMATSUTAKE – AN UPDATE

Shall we see it soon in the supermarkets?

First published in: Mushroom, the Journal of Wild Mushrooming **22** (4) : 47 – 50, Issue 85, Fall 2004

By Tjakko Stijve, St.-Légier, Switzerland and Maria Angela L. de Almeida Amazonas, Centro Nacional de Pesquisa de Florestas, Embrapa Florestas, Colombo, Paraná, Brazil

Since Paul Stamets presented the Royal Sun Agaricus, also known as the Almond Portobello, in these pages about four years ago, we have not heard much about this tasty mushroom. As a matter of fact, only the medicinal properties of this *Agaricus blazei* Murrill are extolled continuously by many companies offering it at exorbitant prices on the Internet. It is therefore time for an update, because great efforts are being made now in Brazil to exploit its gourmet potential and thus bring it to the consumer.

- *Some history*

In 1945 William Alphonso Murrill discovered an unknown representative of the genus *Agaricus* on the lawn of his friend R. W. Blaze, who lived in Gainsville, Florida. In honour of his friend, he described the new species as *Agaricus blazei* in a not readily accessible scientific journal. For years, this mushroom remains in the dark until it is rediscovered in the 60ies by Japanese coffee growers working in Brazil. It is told that one of them, the scientist Takatoshi Furumoto is intrigued by the observation that the inhabitants of the Piedade/Ibiuna district suffer far less from geriatric afflictions than the rest of the Brazilean population. When investigating the causes of this phenomenon, he discovers that the Piedade people regularly consume a kind of mushroom that is unknown elsewhere.
The story is undoubtedly a latter date fabrication to render the healing powers of this mushroom more plausible. In reality, the inhabitants of Piedade have never eaten this mushroom, which is, today, not even common in their area. Furumoto was rather captivated by its excellent taste and texture which reminded him of the famous Matsutake, a delicious edible but rare and expensive mushroom in Japan. He sent therefore samples of the Brazilean mushroom to Japanese universities, and he also consulted the well-known Belgian agaricologist, Dr Paul Heinemann, who identified the species as *A. blazei* Murrill. Over the years, the Japanese managed to cultivate the mushroom. Initially, they called it "Kawariharatake", which corresponds more or less with its habitus, until the day that a child, delighted by the elegant stature of these agarics, exclaimed : "they look like real princesses!" From that day, the Japanese call them "Princess mushrooms" or "Himematsutake". It was soon discovered that both mycelium and fruitbodies have unusually high concentrations of beta glucans, immuno-potentiating polysaccharides, which also inhibit the growth of malignant tumors. Consequently, the healing properties of this mushroom were intensively studied, and *A. blazei*-based medicinal drugs are now readily available on the Japanese market.

- *Description, taxonomic position – and a long overdue name change*

Heinemann gives the following description of the mushroom : **cap** 5 – 11 cm broad, first convex, than plane in age, surface pale brown to brown with fine scales. Margin inrolled when young. **Stalk** 6 – 13 cm long, 1 – 2 cm thick, cylindric, hollow, white, but yellowing

when crushed. **Veil** membranous whitish to brownish with brownish particles on underside. **Gills** very close, free, whitish becoming brownish, then chocolate-brown. **Flesh** firm, white, turning yellow-orange when cut. Odour sweet, of almonds. Spore print chocolate brown.
The photos (figs 1-3) show the robust cultivated form. The carpophores are reminiscent of those of The Prince (*A. augustus*), and they share indeed its excellent taste and – to some extent – the flavour, and its yellowish bruising flesh. Certain mycologists rather compare *A. blazei* to *A. subrufescens*, a species that only stains very slightly yellowish, but which also has a pronounced almondy flavour. It is interesting to note that this "Almond Mushroom" was cultivated about 100 years ago in California, where it soon lost against the competition of the good old white Button mushroom. Apparently, at that time, the almond flavour did not appeal to the average customer. Other specialists see a close relationship with *A. silvaticus*, in spite of the fact that this is a red bruising species! Recent taxonomical studies by Solomon Wasser and his co-workers indicated that the widely cultivated mushroom is not identical with the species described as *A. blazei* by Murrill. The differences are important enough to justify a name change. To render to Caesar what belongs to Caesar, the mushroom was rebaptized and called *Agaricus brasiliensis.* The use of this new name is encouraged.

- *Growing the Royal Sun Agaricus is no big deal*

Companies selling miracle drugs based on *A. blazei = A. brasiliensis* on the Internet, justify their high prices by pointing out that the mushroom is difficult to grow. Agricultural companies in Brazil pretend that the climate of their country is the secret of successful outdoor cultivation, because *A. brasiliensis* likes warmth and light.
For a long time, detailed descriptions of methods for growing this mushroom were scarce indeed, until Paul Stamets included it in his well-known manual, and pointed out that it was no more difficult to cultivate than the White Button (*A. bisporus*). Indeed, Stamets not only cultivates it on leached cow dung and enriched sawdust (5 pounds of this substrate yield 1 lb of mushroom), but also informs the reader that the Royal Sun Agaricus can be grown in good yield on recycled sawdust blocks from the end of the cultivation cycles of other mushrooms, e.g. Shiitake and *Pleurotus*.
Recently, Delphine Delavy of the Laboratory for microbiology of the Neuchâtel University in Switzerland, has devoted her "travail de diplôme" to the study of cultivating *A. brasiliensis*. Initially, she thought that obtaining carpophores in the laboratory would be a real challenge, but it proved surprisingly easy by classic agar culture, followed by grain-to-grain transfer, compost and casing. Moreover, mushrooms were readily obtained at a temperature of 20 – 22° C, indicating that, contrary to common opinion, *A. brasiliensis* is not a thermophilic species! The lower limit of fruiting was 18,5° C.
Delavy confirmed Stamets' observations that the mushroom grows on a wide variety of substrates, including the recycled ones used for cultivating other edibles. Clearly, the cultivation method has a marked influence on the aspect and composition. In general, composted horse manure will yield fruitbodies with darker coloured caps than those obtained from cultures on sawdust.
In Brazil mound culture of *A. brasiliensis* has been practiced successfully for the past 25 years.The mushrooms are harvested when the gills are still covered by the partial veil. In this condition they can be sold as first quality, but to ensure a long shelflife they should be rapidly stored at a temperature of 3 – 4° C.
The agarics can be sold fresh, but most of the harvest is dried. The best quality consists of closed veil and thick fleshed fruitbodies, cut length-wise and dried in a warm air current. The Brazileans call it Cogumelo do Sol (Sun mushroom).

Since it grows at room temperature, there is no reason why the successful cultivation of this mushroom should be limited to tropical and semi-tropical countries.
Apart from the time-honoured *A. bisporus = A. brunnescens,* there are few if any cultivated *Agaricus* species on the market. *A. bitorquis,* also known as Urban Agaricus, and held in high esteem by David Arora, has been grown in several countries, but apparently did not make it. Stamets mentions in chapter 3 of his manual three delicious agarics, *A. augustus, - sylvicola and - arvensis* as candidates for cultivation, but the American consumer has not seen them yet. The Swiss Company MYCOTEC produces a whole range of excellent edibles, but there is no *Agaricus* among them. I was therefore much surprised to see early last year a new agaric on the markets in Geneva and Lausanne. The mushroom was offered as firm white to slightly yellow, still closed fruitbodies at 4 frs = $ 3,-/ 100 g under the name of "agaric de jachères", which we know as the Horse mushroom *(A. arvensis*). Taste and texture proved excellent, the flavour was slightly anise-like.
The Horse mushroom was already successfully grown about 10 years ago, notably in Holland and in the UK, but apparently it took a long time to reach the market. The mushrooms now sold in Switzerland are imported from Holland, and seem to have found some consumer acceptance. Both *A. arvensis* and *A. brasiliensis* belong to the same subsection of the genus. It is interesting to note that the Germans call representatives of this group "Edelpilze", which means noble or choice mushrooms.

- *Nutritional qualities – Flavour and taste compounds*

The dried mushrooms retain about 7 % of moisture. The dry matter has the following average composition : 38 % protein, 40 % carbohydrates, 3 % fat, and about 7 percent of mineral compounds including 2,5 % potassium, 1 % phosphorus and 0,1 % magnesium. Moreover, *A. brasiliensis* contains nutritionally important amounts of B vitamins, niacin, and even vitamin D plus the essential trace elements iron, manganese, zinc and copper.
Recently, the present authors had the opportunity to study the composition of dried *A. brasiliensis* from various origin. Upon investigating the pleasant almond flavour, it was observed that benzaldehyde and its precursor benzoic acid were major components of the mushroom's volatile fraction. Other compounds contributing to the flavour were benzyl alcohol, methylbenzoate and 4-hydroxybenzaldehyde. When soaking the dried mushrooms in water, almond flavour develops, presumably by enzymic conversion of benzoic acid to benzaldehyde and benzyl alcohol, compounds which have also been found in *A. subrufescens* and *A. augustus*. Benzoic acid is a classic food preservative and, since it is naturally present in the Royal Sun Agaricus at concentrations of 0,13 – 0,30 % on dry weight, it may well contribute to its excellent shelf life ! Interestingly, benzoic acid also occurs in several close relatives of *A. brasiliensis*, suggesting that the compound could be a taxonomic marker.
Among the non-volatile taste compounds, mannitol predominated to the extent of 22 %. This well-known safe sugar substitute occurs naturally and widely in mushrooms. Contents of taste-enhancing glutamic- and aspartic acids were comparable to those reported in the White button mushroom.

- *Potential toxic compounds*

Many related edible agarics are known to contain toxic substances, notably cadmium, mercury and agaritine. The readers will be familiar with the two heavy metals, but not everybody will have heard about agaritine. This compound is a phenylhydrazine derivative occurring naturally at relatively high concentrations in many mushrooms belonging to the genus *Agaricus,* including the White button. Agaritine is suspected to cause cancer because of

its structural similarity to known carcinogenic hydrazines. However, 25 years of research including assays in experimental animals with both agaritine and White button mushrooms failed to produce convincing evidence. At worst, the carcinogenicity of agaritine is such that an average mushroom consumption of 4 g /day would be expected to contribute a cumulative cancer risk of about two cases per 100,000 lives.
We investigated dried *A. brasiliensis* not only for these toxicants, but also for other trace elements, radionuclides and pesticide residues. The results were rather reassuring. Regardless of its origin, the mushroom was found to contain the same amount of agaritine as the White button mushroom. Pesticides and radionuclides tested negative in *A. brasiliensis* ex USA and Brazil, whereas a sample from China contained a little benzene hexachloride (BHC) and deltamethrin. Among the trace elements studied, excessive cadmium may be a potential problem. Still, concentrations of this heavy metal in the mushrooms from the USA and Brazil complied with European legislation, but a sample from China did not. However, cadmium levels in Oysters and Shiitake, two widely consumed mushrooms, also occasionally exceed the EEC limit, which may have been set too low. This also applies to the above-mentioned Horse mushroom cultivated in Holland. The first flush of its fruitbodies often has slightly too much cadmium, but the following flushes are OK. Needless to say, growers should pay attention to the possible heavy metal content of their substrate ingredients.

- *Exploiting the gastronomic potential*

Stamets recommends cooking the sliced mushrooms simply in olive oil at high temperature, and to season with salt, soy sauce and tamari. Eating *A. brasiliensis* is a first order gastronomic experience! Immediately after harvest, its almondy flavour may be a bit too strong, but it decreases to a most pleasant level during the following days. The texture of the cooked mushrooms is far better than those of the ordinary Button mushrooms or Oysters. Until recently, the gastronomic potential of the Royal Sun Agaricus had been sadly neglected, because the mushroom was sold exclusively as a miracle drug. For example, a "champignonniste" in the French town of Touraine who successfully tried his hand at cultivating it, sells his harvest exclusively to the local pharmaceutical laboratories.
In Brazil one is well aware of the problem. Most of the agaric produced there is exported, and the processing to medicinal drugs is done by companies outside Brazil. There is virtually no market for those drugs in the country itself, because Brazil's legislation, like that of many European countries, prohibits the sale of medicines of which the beneficial action has not been duly substantiated.
Consequently, great efforts are being made to promote the sale of the CHAMPIGNON DO BRASIL as a gourmet mushroom. Six years ago, 5 growers in the state of Sao Paulo founded the Company GAPI = Grupo Agaricus de Pilar Ltda. GAPI produces now high quality dried and canned *A. brasiliensis*, and a series of derived products, containing the mushroom as a major ingredient. Collaboration was established with EMBRAPA FLORESTAS, a Research Institute dealing with Forestry, belonging to the Ministry of Agriculture. It has recently published a most attractive brochure on the mushroom under the title *Champignon do Brasil* (Agaricus brasiliensis) – *Ciência, Saúde e Sabor* (Science, health and taste). This booklet starts by pointing out the enormous potential of Brazil for mushroom growing. As a matter of fact, South America is far behind in this field. It contributes only 0,2 % of the World production of edible mushrooms, and Brazil's participation is less than 0,01 %. Since the country disposes of enormous quantities of agricultural wastes, e.g. sugarcane bagasse, which are excellent substrate materials, Brazil could well become a World leader in mushroom growing. However, to achieve this, the Brazileans should first become far more mushroom-minded. The only edible species they know is the White button, mostly served as the eternal

risoto ao funghi. Other cultivated edibles, even Oysters, are virtually unknown, although some Asian immigrants practice small scale Shiitake growing. Wild mushrooms are not popular either. The forests abound with edible species, which are not gathered, with the possible exception of *Suillus luteus* (Slippery Jack). However, unlike the Chileans who export large quantities of this mushroom to Europe, where the food industry uses it as an ingredient in soups and sauces, the Brazileans have sofar ignored this commercial potential. Significantly, there is not yet a field guide to the mushrooms of Brazil, but we may expect to see soon an illustrated provisional mycological inventory of Paraná State by Dutch specialist André de Meijer. Portuguese and English editions are in preparation.
The above-mentioned brochure (photo) could well be an important first step in familiarising the inhabitants of this enormous country with mushrooms, especially since the Royal Sun Agaricus is a genuine Brazilean product. The mushroom is recommended as *um alimento especial* which can be prepared in various ways. Paulo Siqueira, chef cook and co-author, gives not less than a dozen mouth-watering recipes for, among others, soups, crackers, pastry, ice cream, pudding and even sausages!
Last year, several of these products were presented successfully at the agricultural trade fair BIO FACH, held at Nuremberg in Germany. It is interesting to note that the Bratwurst prepared with the *Agaricus* appealed to the German taste!

- *How about the future?*

At present, the mushroom is cultivated commercially in Brazil, Japan, China, Korea, and the USA. In Europe, small-scale growing has just started in some countries. Regrettably, in spite of its culinary appeal, the predominant sales argument for *A. brasiliensis* are its (often exaggerated) medicinal virtues. However, the case of the Hen-of-the-Woods (*Grifola frondosa*) demonstrates that consumption of a once rare and expensive mushroom can spread widely in a short time. About 10 years ago, this mushroom, also known as "Maitake", was sold as an expensive medicine, but only in Japan and China. Since European and American growers have mastered its culture, it is sold – among others – at the Swiss market for about the same price as Chanterelle mushrooms. Indeed, the price of *A. brasiliensis* could decrease rapidly, once Brazil or China starts to export the agaric on a large scale. Before long, both American and European consumers would then, after appropriate marketing, readily accept this delicious new mushroom!

- *To know more about it*

Paul Stamets 2000 – Call it Himematsutake or call it the Almond Portobello – It is special. *Mushroom, the Journal of Wild Mushrooming* (USA), 18(3) : 10 – 13

Paul Stamets 2000 – Growing Gourmet and Medicinal Mushrooms. Chapter 21, Third edition. Ten Speed Press, Berkeley, CA.

Tjakko Stijve and Maria Angela L. de A. Amazonas 2002 – Flavour and Taste Components of *Agaricus blazei* ss. Heinem. – A New Gourmet and Medicinal Mushroom. *Deutsche Lebensmittel Rundschau* **98**: 448 – 453.

Tjakko Stijve *et al.* 2003 – Potential toxic constituents of *Agaricus brasiliensis* (*A. blazei* ss. Heinem.) as Compared to Other Cultivated and Wild-Growing Edible Mushrooms. *Deutsche Lebensmittel Rundschau* **99**: 475 – 481.

CAPTIONS BY PHOTOGRAPHS

Pictures 1, 2 and 3 have been taken at the mushroom farm of grower Aldinei Mussy, located in Guarapava, Paraná, Brazil.

1. The freshly picked fruitbodies of cultivated *A. brasiliensis.*

2. An abundant flush of the Cogumelo do Sol (Sun mushroom) as it is called in Brazil.

3. Three scientists observing *A. brasiliensis*. From left to right: Dalva Santana (entomologist), Angela Amazonas (mycologist), both working at Embrapa Florestas, a Research Institute dealing with Forestry, belonging to the Ministry of Agriculture, in Colombo, Paraná, and Renato Rau, pharmacologist at the Institute for Technology of Paraná, in Curitiba, Capital of Paraná State.

4. The mushrooms as sold : cut length-wise and dried.

5. A brochure and a folder advertising the mushroom as a healthy gourmet food.