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Paxillus involutus – a dangerous mushroom?

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The toxicological importance of Paxillus involutus is discussed controversially. Therefore it is necessary to give a critical review about this problem. In the mycological literature printed before 1970 Paxillus involutus was estimated as an edible mushroom of well taste. The only premise to avoid an toxication with gastrointestinal symptoms was the destruction of heatlabile toxins by heating the mushroom longer than 20 minutes.

Despite the mushroom were heated long enough, between 1940 and 1960 the number of severe intoxication caused by Paxillus involutus increased. The German mycologist J. Schäffer died after an ingestion of Paxillus involutus whereas all other participants of the meal did not show any symptoms of an intoxication. The mushroom intoxications recorded between 1961 and 1989 in the former GDR showed an increase of intoxications with Paxillus involutus till 1976. After an action of instructing people the number of intoxications decreased again.

Investigations of Deicher and Strangel (1977) and Winkelmann et al. (1986) showed that in the region of Hannover about half of the population of Paxillus involutus contained an unknown antigen, which causes a so called "immunehaemolytic anaemia" including following symptoms: Vomiting, abdominal pain, circulatory shock, icterus, haemolysis, anuria and pulmonary failure. A repeated contact induces the production of IgG which is liberated by a following ingestion, inducing haemolysis and the other above effects. The mushrooms containing the antigen and those without antigen can only be discriminated by specific immunological methods.

It is concluded that the use of Paxillus involutus as human food is dangerous because of the risk of a sensibilization followed by an immunehaemolytic anaemia.

The possible reasons of the increase of the "Paxillus syndrome" and the territorial distribution of the dangerous variant of Paxillus involutus are discussed.

Key words: Paxillus involutus, mushroom intoxication, immunehaemolysis, "Paxillus syndrome"

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Je podán kritický přehled o otravách čechratkou podvinutou (Paxillus involutus). Paxillus syndrom se vyznačuje jak gastrointestinálními symptomy (syrové či nedovařené plodnice) tak imunohemolytickou anémií po opakovaném požití vařené houby. Z těchto důvodů je třeba houbu považovat za jedovatou, i když ji starší příručky řadily mezi druhy jedlé.

The toxicity of *Paxillus involutus* is discussed controversially – therefore a critical review might be necessary.

The brown roll-rim – *Paxillus involutus* – is a common mushroom in Europe (Fig. 1). The cap of this mushroom is a medium dark dingy yellow brown, and the margin is inroled and market with short riblike lines for furrows. The edge of the cap may be slightly pubescent but is never bearded. The gills are close narrow, decurent, and yellow when young but stained brown if touched or hurt. Cross vains are often conspirous between the gills. Fruity bodies can be found from

June till September in coniferous forests but also under deciduous trees. If necessary (in unclear intoxications) *Paxillus involutus* can be identified in asservates by the typical spores (Kell 1961, Pohle and Wöllner-Siebert 1983), which are 8-10 x 5-6 μm in size, ellipsoid, dull brownish yellow, smooth and containing a large drop (Fig. 2).

In the mycological literature published before 1975 *Paxillus involutus* is designed as edible. Toxic compounds can be destroyed by heating like in some other mushrooms. Here some examples are given: Amann (1966): "Roh giftig, gut durchgekocht ein schmackhafter Speisepilz." Lange and Hora (1941): "Harmless if cooked, of little value; slightly poisonous to some people when raw." Michael and Hennig (1968): " – wird als ausgezeichneter Speisepilz gern gegessen" – "Längeres Braten (25 Min.) ist unbedingt erforderlich!" Moser (1967): " – Kann roh oder schlecht gekocht stark giftig wirken!" Pilat (1954): "Mushroom of inferior quality which can only be eaten boiled. Raw it causes indigestions in some persons." Ramsbottom (1923): " – taste mild" – "edible". Romagnesi (1977): "En France, cette espéce est consomé sans inconvéniment lorsqu'elle est bien cuite; mais crue ou insufisamente cuite, ell est extrémement toxique". Smith and Smith-Weber (1980): "In Poland a study was made over a period of 10 years. In 109 cases studied 93 were hospitalised and there were 3 fatalities. Apparently, the mushrooms were not cooked sufficiently. Never eat this species raw! In past it has been rated as an edible species – and it is true that an North America it has been used for the table fairly frequently."

In Germany intoxications caused by *Paxillus involutus* which were insufficiently cooked had been very rare. During and after the "second war" the intoxications increased drastically despite the fact that the fruity bodies of *Paxillus involutus* were heated well. Also the German mycologist J. Schäffer died after having eaten *Paxillus involutus* whereas his family remained without any symptoms.

Before 1961 we do not have exact informations about the number of intoxications, but between 1961 and 1989 in the eastern part of Germany (former GDR) mushroom intoxication had been registrated (Fig. 3). Between 1966 and 1976 the number of intoxications caused by *Paxillus involutus* further increased drastically (1968 – 56 and 1974 – 45 cases). – A large action of instructing people was started – and after some years the number of intoxication decreased again. Several cases were reported (Cochet 1974, Grzymala 1958, Herrmann 1961, Rauschert 1962, Sikorski, Marciniak and Gliniecka 1974, Straus 1949) but only Bschorr and Mallach (1963) and Kubička and Veselský (1975) suggested that also well heated fruity bodies of *Paxillus involutus* might be dangerous.

Between 1971 and 1986 in several publications the "Paxillus syndrome" was investigated and analysed (Albrecht 1983, Azema 1982, Bschorr and Mallach 1963, Cochet 1974, Deicher and Strangel 1977, Flammer 1985, Lagrande 1979, 1982, Lefévre 1982, Nieminen et al. 1977, Olesen 1991, Schmidt et al. 1971, Winkelmann

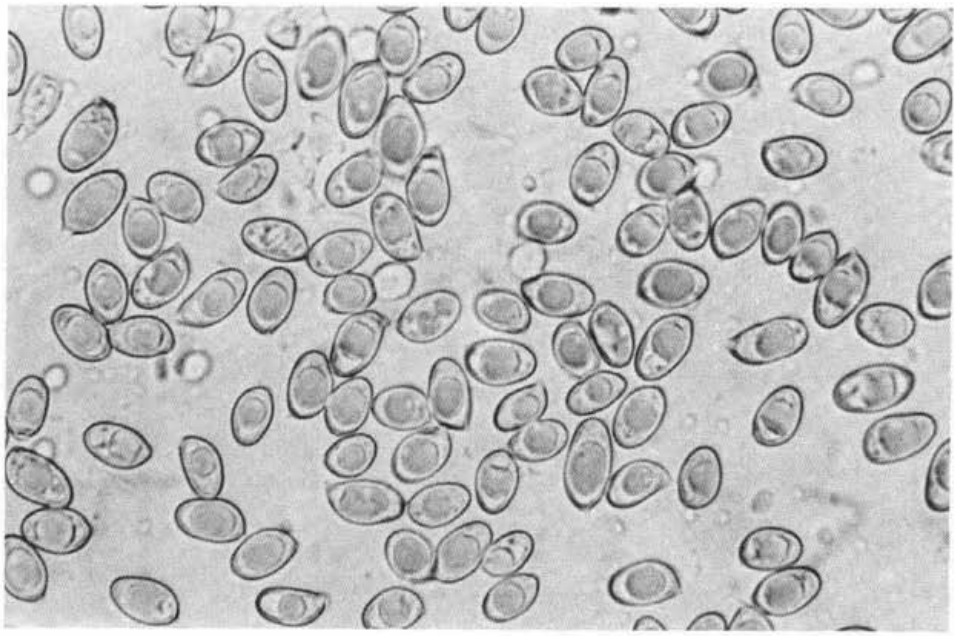

Fig. 1 The brown roll-rim – Paxillus involutus.

Fig. 2 Spores of Paxillus involutus.

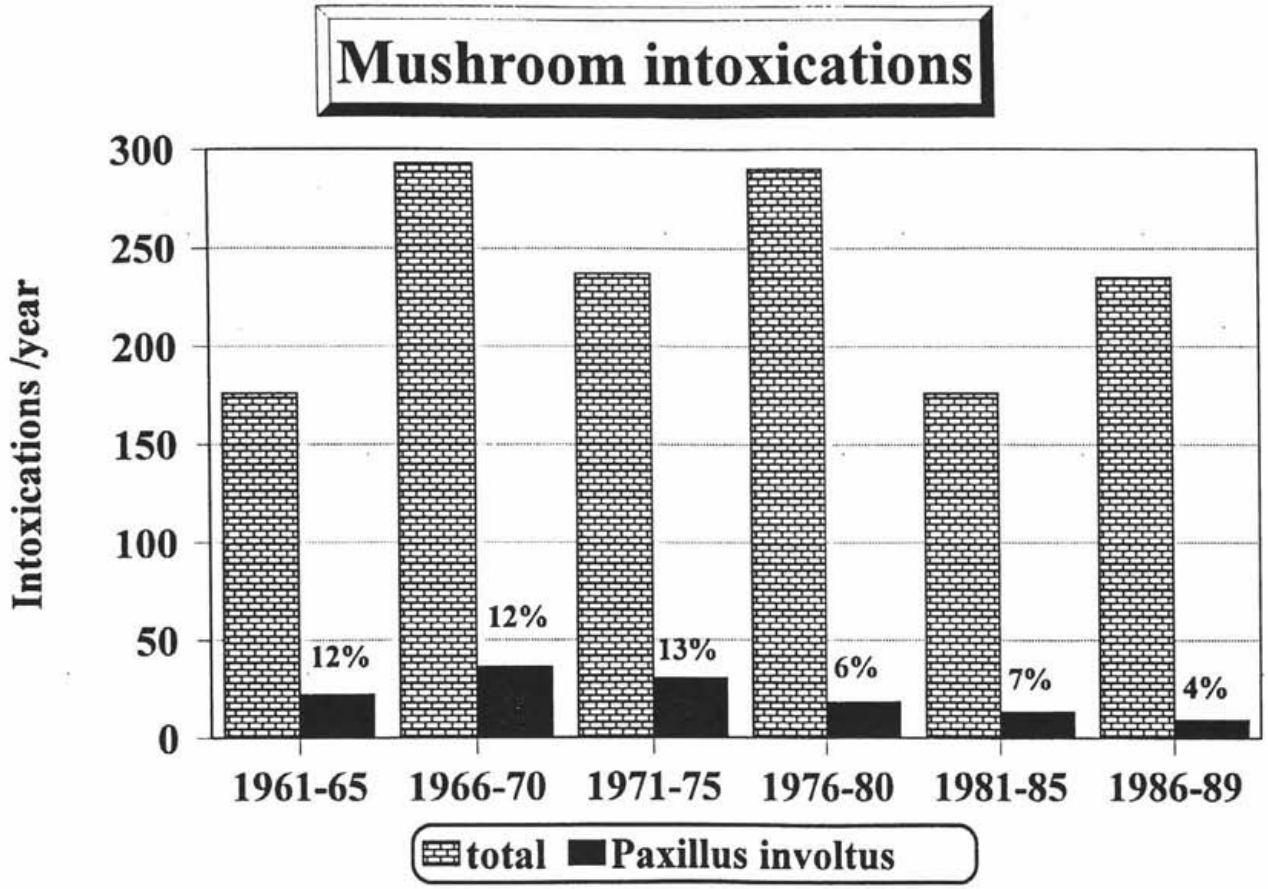

Fig. 3 Mushroom intoxication in the eastern part of Germany (former GDR). Always the mean of 5 years is shown as intoxication per year.

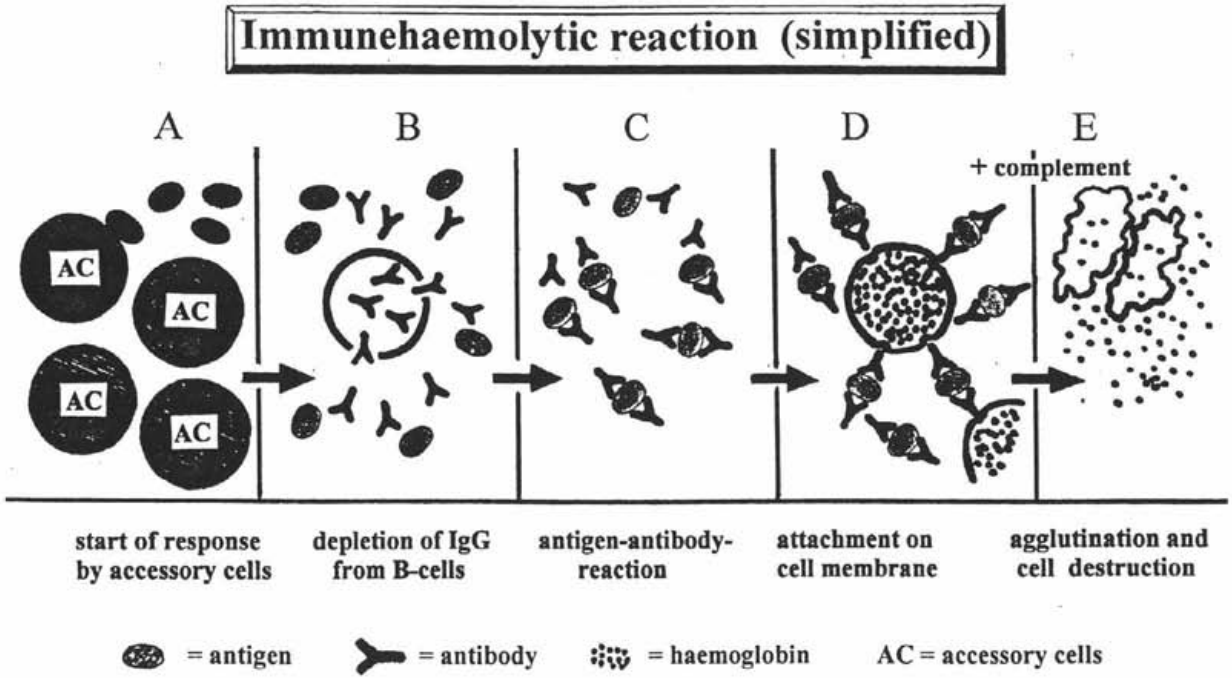

Fig. 4 Scheme of the immunehaemolytic reaction demonstrated in a simplifier manner.

et al. 1982, Winkelmann et al. 1986), and the results were also cited in the new mycological literature (Bresinsky and Besl 1989, 1990, Kell 1961, Michael et al. 1979).

What has happened? – If *Paxillus involutus* was eaten repeatedly, suddenly, about 2 hours after a new ingestion this mushroom following symptoms could appear: weakness, nausea and vomiting, diarrhoea, colique-like abdominal pain, stupor, dyspnoe, circulatory shock, icterus, haemolysis, haemoglobinurea, anuria, ureamia, extrasystoly as well pulmonary and renal failure. Without medical help most patients must die within 2 or 3 days (Deicher and Strangel 1977, Flammer 1985, Lefévre 1982, Olesen 1991, Schmidt et al. 1971, Winkelmann et al. 1982, Winkelmann et al. 1986).

Post mortal examinations revealed signs of intravascular coagulations in lungs, kidneys, adrenals, myocardium, liver and spleen; – and also extensive fat embolism to the lung could be found (Deicher and Strangel 1977, Winkelmann et al. 1986). In the serum of the patients an antibody against *Paxillus involutus* was found (Deicher and Strangel 1977, Winkelmann et al. 1982, Winkelmann et al. 1986).

The "Paxillus syndrome" is no really intoxication, but a pathological immune reaction called "immuneheamolytic anaemia". This immune reaction is shown in a simplified manner in Fig. 4: During repeated confrontation with the till unknown antigen from *Paxillus involutus* antibodies were formed by the help of akzessory cells (Fig. 4, "A"), and if enough IgG-antibodies are synthesised a new contact with the antigen induces a more or less intense depletion of IgG from B-cells (Fig. 4, "B") (Roitt et al. 1987). The IgG-molecules react with the antigen in an antigen-antibody-reaction (Fig. 4, "C") (Winkelmann et al. 1982, Winkelmann et al. 1986). The former immune complexes now can be attached to the surface of the erythrocyte membrane (Fig. 4, "D"), and (by help of the complement chain) it is followed by the agglutination and destruction of this red blood cells (Fig. 4, "E"). – Haemoglobin emits from the damaged cells into the serum followed by haemoglobinnuria and other secondary effects as kidney damage and so on. The "Paxillus syndrome" is called to be an "immunehaemolytic anaemia". Immune reaction against other mushrooms are known (Albrecht 1983, Bruhn and Sonderberg 1991), but they must not be all as fatal as the immunehaemolysis caused by *Paxillus involutus*.

In addition to an adequate anti-shock treatment, elimination of the former immune compounds, liberation haemoglobin and erythrocyte debris by plasma separation and the compensation of renal failure by haemodialysis seem to be the therapy of choice (Winkelmann et al. 1986).

Not all fruity bodies of *Paxillus involutus* contain the dangerous antigen. Around Hannover mushrooms from several different populations of *Paxillus involutus* were investigated by a special immunological method using serum from patients who had been suffering from Paxillus disease. Deicher and Strangel (1977) and Winkelmann

et al. (1982, 1986) from the Medical School Hannover found that 7 out of 12 of the investigated population of *Paxillus involutus* contained the unknown dangerous antigen, and it can be suggested that the regional distribution of the dangerous and the harmless populations of the *Paxillus involutus* seems to be different. The harmless mushrooms and those containing the dangerous antigen do not differ in their morphology, and a differentiation is only possible by immunological methods.

In the Moscow region *Paxillus involutus* was the most used mushroom over long time, and no intoxication were published before 1991. Immunological investigation from this region are unknown.

As shown by the literature *Paxillus involutus* was eaten without any trouble in France and North America, but much intoxications were reported from Poland and Germany (Romagnesi 1977, Smith and Smith-Weber 1980). Also Kreisel (Michael et al. 1979) pointed out that territorial differences in the toxicity of *Paxillus involutus* may exist.

What about the sudden increase of the dangerous disease caused by *Paxillus involutus*? This question can only be answered hypothetically, and there are 3 possibilities:

1) Several years ago a population of *Paxillus involutus* was changed by a mutation to form the dangerous antigen. This new mutation extended more and more in Europe.
2) Both the harmless and the dangerous form did exist long ago. The immunehaemolytic anaemia was unknown, and for it in the most cases only one person out of a group was affected the association between *Paxillus involutus* and the illness was ignored. The cases were not registrated as intoxications.
3) Both variants with and without the dangerous antigen did exist long time ago, but due to the contamination of our environment by toxic agents people had become more sensitive against antigens. Therefore in general people may faster develop a sensibilization against antigens than years before.

To elucidate this open problem it will be of interest to investigate the territorial distribution of the dangerous variant of *Paxillus involutus* in a larger region than around Hannover. It will be helpful to investigate whether the territorial distribution of the dangerous variant of *Paxillus involutus* corresponds to the territorial distribution of the immunehaemolytic anaemia caused by this mushroom.

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