MUSHROOM POISONING – IS IT BECOMING AN INCREASINGLY SERIOUS PROBLEM?

Zatrucie grzybami – czy to coraz poważniejszy problem?

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Abstract

Introduction and objective: Mushrooms have remained popular for years. The positive effects they have on the human body are increasingly emphasized. Despite the increase in knowledge among mushroom pickers, Polish hospitals still admit patients with symptoms of poisoning. This study analyzes poisoning caused by the consumption of mushrooms in adults, based on hospitalization records in the Clinical Department of Toxicology and Cardiology of the Cardinal Stefan Wyszyński Regional Specialist Hospital in Lublin. The aim of the study is to assess whether the problem of mushroom poisoning is increasing. **Material and methods:** This study had a retrospective character. Medical records of 1,539 adult patients hospitalized because of intoxication were analyzed. Of these, a group of 14 patients with mushroom poisoning was identified. **Results:** Of the patients hospitalized in 2021–2022, 14 were diagnosed with mushroom poisoning. Among them, 9 were male (64.29%) and 5 were female (35.71%). The age range of the study subjects was 25–92 years. The patients lived mainly in rural areas (9 individuals). The majority (64.29%) had collected the mushrooms on their own, and in two cases there was collective poisoning. The highest number of cases was recorded in the summer-autumn months, with most incidents occurring in September. Symptoms usually appeared between 7 and 12 hours after ingestion. The average length of hospital stay was 7.1 days. No deaths were reported in the study group. **Conclusions:** A decrease in the number of poisonings was observed. It is necessary to raise awareness about the consequences of consuming poisonous mushrooms and how to identify them. It is important to highlight the safety of eating cultivated mushrooms.

Streszczenie

Wprowadzenie i cel: Grzyby od lat cieszą się niesłabnącą popularnością. O ich pozytywnym wpływie na organizm człowieka słyszy się coraz częściej. Mimo wzrostu wiedzy wśród grzybiarzy na ich temat, do polskich szpitali wciąż trafiają pacjenci z objawami zatrucia. W niniejszej pracy dokonano analizy zatruć spowodowanych spożyciem grzybów przez osoby dorosłe na podstawie dokumentacji hospitalizacji w Klinicznym Oddziale Toksykologiczno-Kardiologicznym Wojewódzkiego Szpitala Specjalistycznego im. Stefana Kardynała Wyszyńskiego w Lublinie. Celem badania jest ocena, czy problem zatruć grzybami narasta. **Materiał i metody:** Badanie miało charakter retrospektywny. Wykorzystano analizę dokumentacji medycznej 1539 dorosłych pacjentów hospitalizowanych w latach 2021–2022 z powodu zatruć. Spośród nich wybrano grupę 14 osób zatrutych grzybami. **Wyniki:** Spośród pacjentów hospitalizowanych w latach 2021–2022 u 14 zdiagnozowano zatrucie grzybami. W badanej grupie było 9 mężczyzn (64,29%)

i 5 kobiet (35,71%). Przedział wiekowy badanych wynosił 25–92 lata. Pacjenci mieszkali głównie na obszarach wiejskich (9 osób). Większość (64,29%) zbierała grzyby samodzielnie, a w dwóch przypadkach doszło do zatrucia zbiorowego. Największą liczbę zatruć zaobserwowano w miesiącach letnio-jesiennych, najwięcej we wrześniu. Objawy pojawiały się zwykle między 7. a 12. godziną po spożyciu. Średnia długość pobytu na oddziale wynosiła 7,1 dnia. W badanej grupie nie zaobserwowano zgonów. **Wnioski:** Zaobserwowano spadek liczby zatruć grzybami. Konieczne jest rozpowszechnianie informacji o konsekwencjach spożywania grzybów trujących i sposobach ich identyfikacji. Ważne jest podkreślanie bezpieczeństwa spożywania grzybów uprawnych.

Keywords: adults; mushrooms; poisoning; amanitin

Słowa kluczowe: dorośli; grzyby; zatrucie; amanityna

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Introduction and purpose

Mushrooms are a group of eukaryotic organisms classified in their own kingdom, with approximately 100,000 known species. Around 50–100 of these are considered poisonous [1].

Mushrooms have a long history of use in both medicinal and culinary contexts, dating back thousands of years. As early as 400 BC, Hippocrates noted their medicinal properties. The ancient Greeks also recognized their potential dangers; for instance, Euripides mourned the tragic death of a mother and her three children after consuming mushrooms – one of the earliest references to their toxicity in ancient Greek literature [2]. In the modern era, significant discoveries have been made in the field of mycology. Penicillin, the first antibiotic, was isolated from molds in 1938 by Alexander Fleming, Howard Florey, and Ernst Chain. Molds also play a role in the development of certain cheeses, while yeast is essential in the production of wine and baked goods. Despite these positive uses, mushrooms also have a darker side – hallucinogenic and poisonous species pose significant risks to health.

Mushrooms have long held cultural significance in various societies, including Polish tradition. For many generations, they have been integral to the diet, as well as a source of recreational activity. In late summer and autumn, families often gather in forests to forage for mushrooms – an activity that strengthens community bonds. In Polish folk culture, mushrooms were even believed to have prophetic powers. Their fertility and sudden abundance were seen as signs of impending major events, such as war or pestilence [3]. This belief in the symbolic power of mushrooms reflects their deep cultural importance.

While mushrooms were historically collected from the wild, their artificial cultivation can be traced back to Asia, with France being the pioneer in Europe, cultivating double-spore mushrooms in the 18th century [4]. Today, cultivated mushrooms are widely consumed and have become a staple in many diets. However, the traditional practice of mushroom foraging has not disappeared, and many still enjoy collecting, preparing, and preserving mushrooms on their own. Mushrooms are now recognized not just for their flavor and aroma, but also for their nutritional and health benefits. Over time, they have evolved from being viewed as an occasional treat or hard-to-digest food to being valued for their medicinal properties and contribution to a balanced diet [5].

While mushrooms offer many benefits, they also pose potential dangers. Some varieties are toxic, and consuming them can lead to serious health issues or even death. The historical reference to mushroom poisoning in ancient Greece highlights the long-standing awareness of these risks. On the other hand, the positive aspects of mushrooms – including their roles in medicine, cuisine, and nutrition – underscore their multifaceted nature. The continued interest in both foraging and cultivating mushrooms reflects both their cultural and culinary importance, as well as their potential health advantages when consumed responsibly.

Mushroom poisoning remains a recurring issue during the summer and autumn seasons. Every year there are several hundred reported cases, some of which end in death. The majority of affected individuals are adults, approximately 70%, and the remainder are pediatric patients under the age of 14 [2, 6, 7]. One of the factors influencing annual poisoning rates is the abundance of mushroom growth in a given year. In practice, this means a reduction in poisonings during poor harvests and climate crisis [6, 8].

It is also worth noting that both poisonous mushrooms and those commonly considered edible can be responsible for poisoning [5]. One of the primary causes is incorrect identification of mushrooms, particularly mistaking toxic species for edible ones. The widespread belief that poisonous mushrooms cause blackening of onions and silverware lacks scientific basis, and even the most experienced mushroom hunters can occasionally misidentify a species.

The most commonly confused edible and poisonous species include:

- *Russula virescens* (green-cracking russula), *Tricholoma equestre* (yellow knight), *Macrolepiota procera* (parasol mushroom) – with *Amanita phalloides* (death cap);
- *Agaricus campestris* (field mushroom) – with *Amanita verna* (destroying angel) and *Amanita virosa*;

- *Morchella esculenta* (morel mushroom) – with *Gyromitra esculenta* (false morel).

An additional concern is the growing interest in mushrooms with hallucinogenic properties, particularly among young people. Easy access to the Internet facilitates obtaining information about the appearance of mushrooms with psychoactive properties, which can lead to misidentification by inexperienced mushroom pickers, potentially resulting in fatal outcomes [9].

The clinical presentation of mushroom poisoning varies depending on the species and the specific toxin consumed, but the most common symptoms include gastrointestinal issues such as nausea, vomiting, abdominal pain, and diarrhea, as well as liver and kidney damage, neurological complications, and respiratory and cardiovascular distress [10].

Initial treatment aims to eliminate any remaining traces of mushrooms from the gastrointestinal tract before toxins are absorbed into the bloodstream. This is commonly achieved through gastric lavage, which is most effective during the early (asymptomatic) phase of poisoning [11]. Unfortunately, patients often seek medical assistance after a significantly longer period. Inducing vomiting is not recommended due to its low effectiveness, potential complications such as aspiration, and potential delays in administering the targeted antidote [12, 13]. The next step in treatment involves reducing the absorption of toxins from the gastrointestinal tract and interrupting the enterohepatic circulation of toxins by administering activated charcoal. Between successive doses of charcoal, suctioning of gastric contents is recommended [2, 6, 11]. To reduce the accumulation of amatoxins in the liver, specific therapy can be applied, which involves administering antidotes within the first 24 hours after poisoning. These antidotes rely primarily on silybilin. Penicillin G, once considered an antidote, is no longer routinely used nowadays; it is administered exceptionally in extremely rare clinical situations [11]. Within the first 24 hours of poisoning, extracorporeal elimination such as hemodialysis may also be employed.

Symptomatic treatment, fluid therapy, and close monitoring of the patient's clinical condition through laboratory tests such as ALT, AST, and INR are standard therapeutic approaches [2, 11].

This study aims to analyze cases of mushroom poisonings in individuals aged 18 and over, hospitalized in the Clinical Department of Toxicology and Cardiology of the Cardinal Stefan Wyszyński Regional Specialist Hospital in Lublin during the years 2021–2022.

Material and methods

The present study was retrospective in nature and based on the analysis of medical records of patients hospitalized in the Clinical Department of Toxicology and Cardiology of the Cardinal Stefan Wyszyński Regional Specialist Hospital in Lublin during the years 2021–2022.

Among 1,539 poisoning-related hospitalizations (ICD-10 codes T36-T65) that occurred during the specified period, a target group of 14 individuals was identified with a primary or concomitant diagnosis of T62.0 (toxic effect of ingested mushrooms).

During the analysis, factors such as age, gender, place of residence, whether the poisoning was intentional or part of a collective incident, the type of mushroom consumed, and whether the subject collected the mushroom themselves, were taken into account. The length of hospitalization, patient condition at admission, and the time from mushroom ingestion to symptom onset were also considered. Additionally, the study examined parameters related to liver and kidney damage and the presence of amanitin in blood serum.

Results

The study group consisted of 14 individuals, with 35.71% (5 individuals) being female and 64.29% (9 individuals) being male. There were no recorded cases of mushroom poisoning in children in the study group. The age of the patients ranged from 25 to 92 years, with a median age of 61 years (Fig. 1).

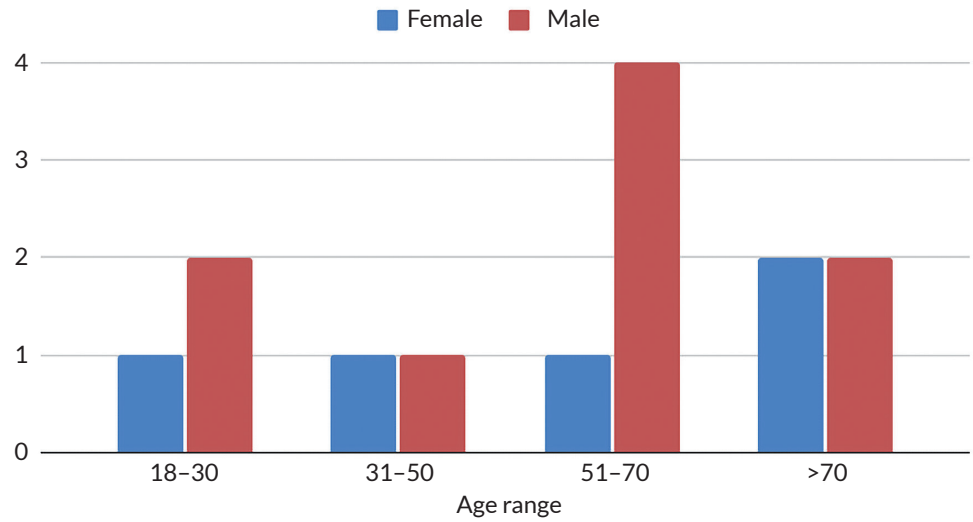

Figure 1. Distribution of the study population by age group and gender

Among the participants, there was a prevalence of individuals residing in rural areas (9 cases, 64.29%) compared to urban settings.

The majority of intoxications (85.71%) were unintentional. Two cases (14.29%) involved collective poisoning (Tab. 1).

Of the affected individuals, 64.29% (9 cases) had personally collected the mushrooms that caused the symptoms. Among those who gathered the mushrooms on their own, two-thirds (6 subjects) lived in rural areas, while the remaining three were urban residents. Alcohol (ethanol) was detected in one patient.

Among the surveyed cases, 9 patients reported consuming mushrooms with a lamellar hymenophore (hymenophore being the part of the mushroom's fruiting body on which the hymenial layer, producing spores, is located) [14].

Analysis of the collected data revealed that the highest number of mushroom poisoning cases occurred in the second half of the year, particularly in late summer and early autumn. In September and October, a total of 9 patients were admitted to the Department, accounting for 64.29% of the study group. The highest number of poisonings was recorded in September (Fig. 2).

The length of patient hospitalization ranged from 3 days (the shortest stay) to 12 days (the longest hospitalization). In 8 cases (57.14%), the hospital stay exceeded 5 days. The average length of stay was 7.1 days, with a median of 7 days (Fig. 3).

The time from mushroom consumption to the onset of symptoms ranged from 4 to 72 hours, with an average of 15.6 hours and a median of 12 hours. In 3 cases (21.43%), the time from ingestion to symptom onset did not exceed 6 hours. Among the surveyed individuals, 3 patients were admitted in severe condition, with the time from mushroom consumption to symptom onset being >6 hours (9, 12, and 16 hours, respectively) (Tab. 2).

After analyzing the medical records, the following information was obtained regarding the tests performed upon patient admission, including liver function parameters (ALT, AST, INR) and the presence of amanitin in the patients' blood serum. Half of the subjects had elevated transaminase values, and 7 individuals also had abnormal INR values. At the time of admission, 2 patients had normal liver function parameters (Tab. 3).

In the examined group, 8 patients (57.14%) had coexisting somatic diseases. Among the participants, 3 individuals developed organ complications, with 2 experiencing liver and kidney dysfunction, and 1 suffering from pulmonary embolism.

Each hospitalized individual underwent the determination of amanitin levels in the blood serum, with 50%

Table 1. List of mushrooms that patients believed they were collecting/eating

Mushroom species	Number of cases	Percentage share
Macrolepiota procera	3	21.43
Russula	3	21.43
Tricholoma equestre	2	14.29
Suillus luteus	2	14.29
Agaricus campestris	1	7.14
Imleria badia	1	7.14
Lactifluus volemus	1	7.14

Table 2. Time elapsed from mushroom consumption to the onset of initial symptoms in individual patients

Time from ingestion to symptom onset	Number of patients	Percentage distribution
<6 hours	3	21.43
7–12 hours	6	42.86
13–18 hours	3	21.43
19–24 hours	0	0.00
25–48 hours	1	7.14
49–72 hours	1	7.14

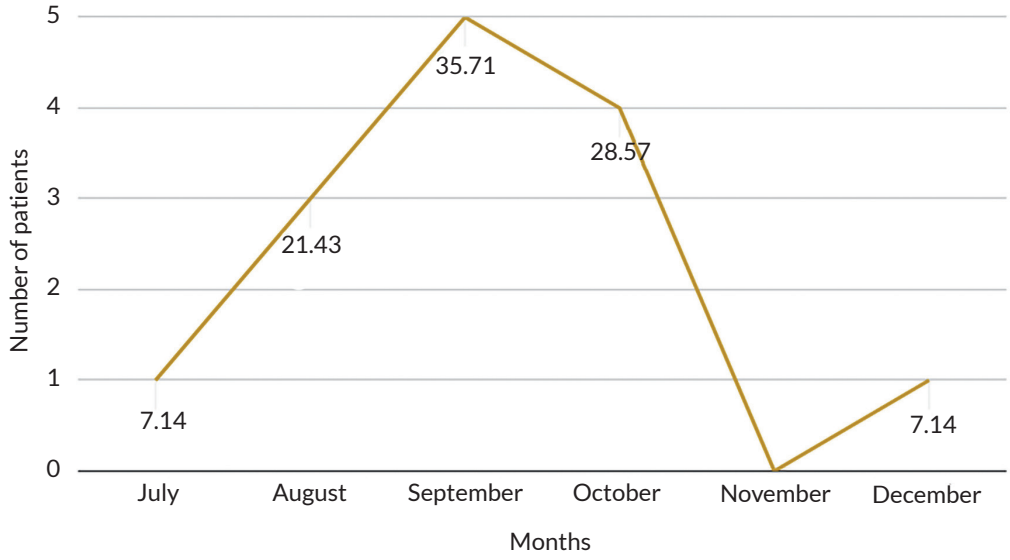

Figure 2. Distribution of mushroom poisoning-related hospitalizations across individual months

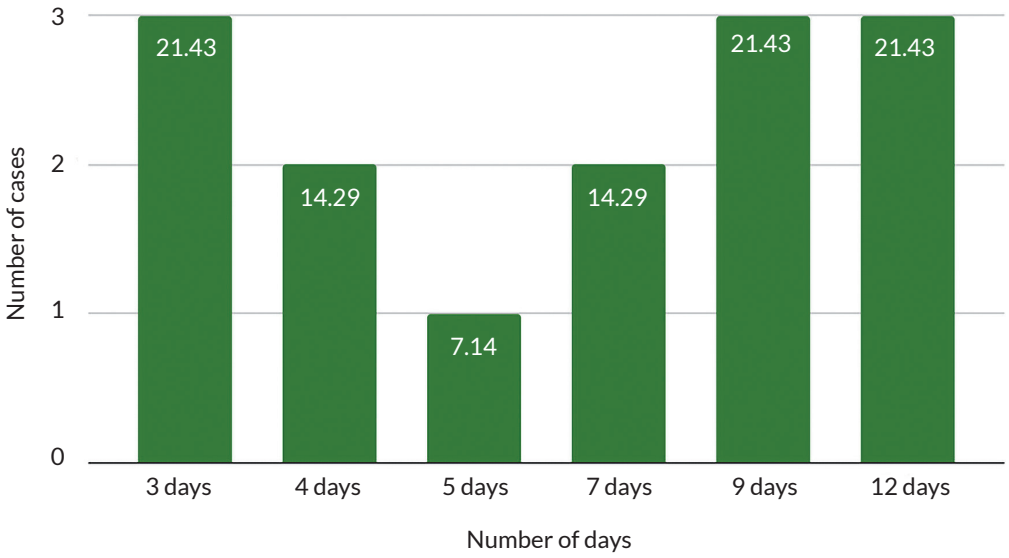

Figure 3. Distribution of the duration of individual hospitalization

Table 3. Biochemical parameter values indicating liver dysfunction measured at admission to the Clinical Department

Parameter	Average value	Value range (min–max)	Scope of standard
Alanine aminotransferase (ALT)	332.86	7–3244	5–41 U/L
Aspartate aminotransferase (AST)	236.57	13–2491	5–38 U/L
International normalized ratio (INR)	2.09	1–12.4	0.80–1.15

yielding a positive result. Among those with a positive amanitin finding, 5 patients (71.43%) had elevated liver enzyme levels, and 3 patients (42.86%) had abnormally high INR values. One person presented with an elevated INR without biochemical evidence of liver damage.

Among patients with a positive amanitin result, the time from mushroom consumption to symptom onset ranged from 5 to 16 hours, with an average of 11.4 hours. The length of hospitalization for these patients varied from 3 to 12 days, with an average of 9.5 days.

Regarding the types of mushrooms consumed by patients with a positive amanitin result, 3 individuals reported eating lamellar mushrooms, 1 person had ingested mushrooms with a tubular hymenophore, and 3 individuals were unsure of the type of mushrooms they had eaten.

In addition, data were collected regarding patients hospitalized in the Clinical Department of Toxicology and Cardiology of the Cardinal Stefan Wyszyński Regional Specialist Hospital in Lublin in 2017–2018 due to mushroom poisoning (Fig. 4).

The medical records of patients with a positive amanitin result were analyzed with regard to three aspects: length of hospitalization, liver damage parameters, and the types of mushrooms consumed by the patients. The results obtained were as follows: out of 36 patients hospitalized during that period, 14 individuals (38.89%) had a positive amanitin result. At admission, 71.4% of the study participants (10 individuals) had elevated liver function parameters (ALT and/or AST), of which 8 individuals also had abnormally high INR values, indicating kidney impairment. Four patients (28.6%) exhibited no signs of liver or kidney damage at admission. The length of hospitalization ranged from 1 to 27 days, with a mean of 10.2 days. It should be noted that the one-day hospitalization in the department was due to the need for patient qualification for liver transplantation and subsequent transfer to another hospital.

Discussion

Although mushroom poisoning is not among the most common causes of hospitalization, several dozen cases are reported each year, some of which result in severe organ complications or even death.

Based on the findings presented in this study, it can be determined that mushroom poisonings accounted for 0.92% of all hospitalizations in the Clinical Department of Toxicology and Cardiology of the Cardinal Stefan Wyszyński Regional Specialist Hospital in Lublin between 2021–2022. It is important to note that this analysis does not fully reflect the scope of the problem of mushroom poisoning, as it only includes patients from the mentioned department. The analysis excludes cases of intoxication among children, a group of patients more commonly admitted to Intensive Care Units. According to data published by the National Institute of Public Health NIH – National Research Institute Department of Epidemiology and Surveillance of Infectious Diseases in 2014–2023, a total of 192 cases of mushroom poisoning were registered in Poland. Of these, 24 cases were re-

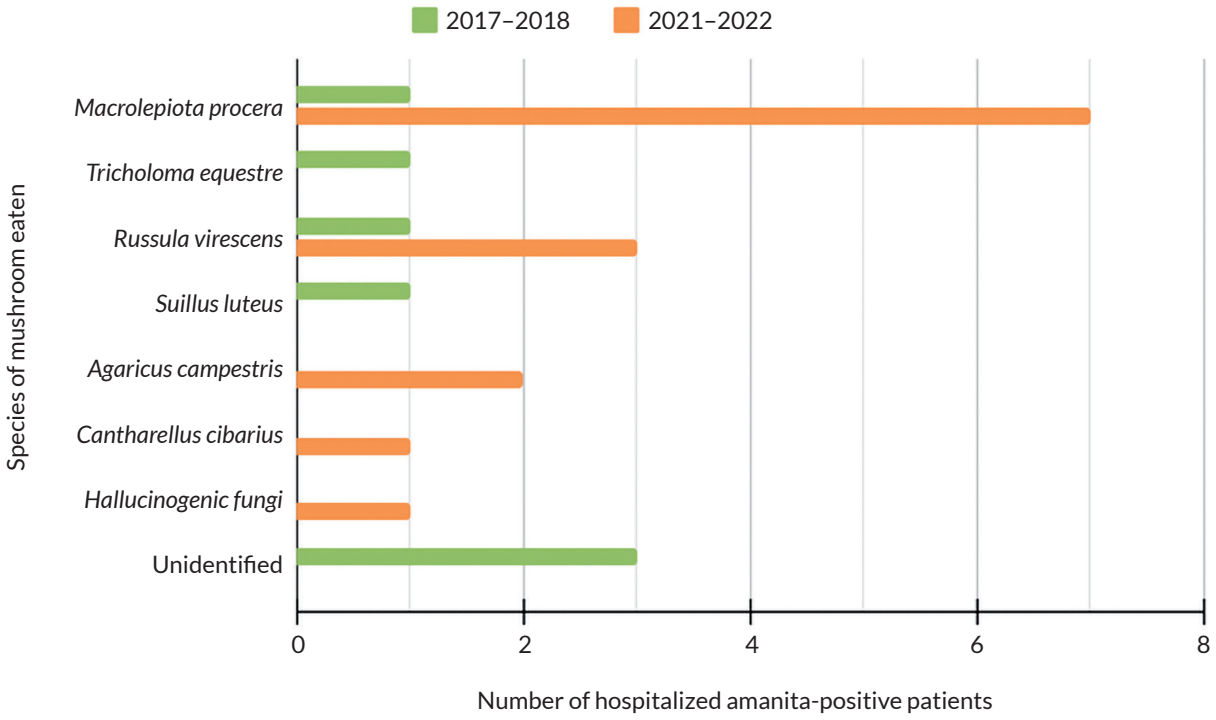

Figure 4. Comparison of mushroom species consumed by patients with a positive amanitin result in 2017–2018 and 2021–2022

ported in 2021–2022. In these 10 years, 59 poisonings were registered in the Lublin Province [15–19].

According to the collected data, 85.7% of mushroom poisoning cases were accidental. The main reasons for intoxication was improper identification of edible and poisonous mushrooms. Other mentioned causes (primarily responsible for gastrointestinal symptoms) included the following [5, 20, 21]:

- large quantity of consumed mushrooms, especially due to the presence of compounds that are difficult to digest, such as chitin, trehalose, and mannitol;
- absence of the enzyme trehalase in the patient's body, which is responsible for breaking down trehalose, as its excess in the intestinal lumen leads to osmotic diarrhea;
- consumption of aged fruiting bodies, improper preparation of dishes from edible mushrooms, and inadequate storage conditions (e.g., using plastic bags for collecting, consuming mushrooms along with alcohol or milk);
- contamination of mushrooms with bacteria, microorganisms, or environmental pollutants in which the fungus grows – including pesticides, heavy metals, and radioactive compounds (e.g., in industrial areas);
- consumption of edible mushrooms by individuals in high-risk groups (e.g., persons with gastrointestinal diseases, children, elderly individuals, pregnant women).

In rare cases, suicide attempts by consuming mushrooms were observed. Another concerning phenomenon was the experimentation with mushrooms exhibiting psychoactive properties, especially among young individuals [9].

Mushroom poisonings can be classified into six categories based on the effects they induce:

I. Cytotoxic poisonings – caused by mushrooms containing cytotoxins (*Amanita*, *Lepiota*, and *Galerina* – each of these may contain amanitin);
II. Neurotoxic poisonings;
III. Myotoxic poisonings;
IV. Poisonings involving metabolic and endocrine disorders;
V. Gastroenterotoxic poisonings;
VI. Various adverse reactions.

This article focuses on two types of poisonings – gastroenterotoxic and cytotoxic – due to their higher frequency of occurrence.

The discussion begins with the fifth group of poisonings, involving fungi with gastroenterotoxic effects, which include the vomiting russula (*Russula emetica*), brown rollrim mushroom (*Paxillus involutus*), woolly milkcap (*Lactarius torminosus*), common earthball (*Scleroderma citrinum*), and livid entoloma (*Entoloma sinuatum*), among others. The precise structure of the toxins in this group remains unidentified in many cases. After ingestion, symptoms of gastrointestinal poisoning typically appear within 6 hours and usually resolve spontaneously. Common symptoms include acute gastroenteritis, manifesting as abdominal pain, nausea, diarrhea, and vomiting. Importantly, no organ damage is usually observed. Deadly poisonous mushrooms contribute to the first type of poisoning, which will be discussed hereinafter. In Poland, the most commonly implicated species are the death cap (*Amanita phalloides*), the destroying angel (*Amanita verna*), and venomous toadstools (*Amanita virosa*) [8, 9]. Their toxins usually have a peptide structure, such as α-amanitin, which is a member of the amatoxin group characterized by its cyclic octapeptide configuration. Amatoxins are among the most potent poisons produced by fungi of the toadstool family, and do not degrade even when subjected to high tempera-

tures. In addition, their toxicity increases when bound to albumin. Their main action occurs at the DNA level by inhibiting protein synthesis in the cells of internal organs, causing their death. Amatoxins have the greatest affinity for the liver; however, they can also damage cells of other organs including the kidneys, pancreas, myocardium, as well as circulating neutrophils and erythrocytes [2, 22]. In this case, the latency period before symptom onset is longer than 6 hours, usually 10–12 hours [7, 20, 23]. This type of poisoning can lead to acute toxic organ damage, primarily affecting the liver and kidneys, which may result in death [24–26].

The treatment of mushroom poisoning can be divided into several stages. The early phase involves gastrointestinal decontamination, primarily through gastric lavage. This intervention is most effective within the first hour after intoxication. However, due to the potential presence of fungal spores in the gastric folds for an extended period, gastric lavage remains justified even beyond 4 hours post-ingestion. Subsequent gastric lavage is also performed for mycological identification purposes [11, 27]. The next stage involves the administration of high doses of activated charcoal (1.0 g/kg body weight), either orally or via gastric lavage probe, in repeated doses every 4–6 hours, at a dose of around 25 g over a 24-hour period [26].

This approach aims to prevent the reabsorption of amatoxins by inhibiting their enterohepatic circulation [6]. During the intervals between successive doses of activated charcoal (prior to administering each dose), the gastric and duodenal contents should be aspirated [11].

The third stage involves the administration of specific treatment. Amatoxins persist in the bloodstream for approximately 12–24 hours before binding to nuclear RNA polymerase II in hepatocytes. Therefore, the window for administering specific antidotes is limited to less than 24 hours. The primary agent used is silybin, which blocks the transport protein, thereby inhibiting the hepatic uptake of amatoxins. Alternatively, benzylpenicillin and cefazolin may be administered. Additionally, N-acetylcysteine is employed independently, following the standard protocol used in acetaminophen poisoning. For secondary detoxification, forced diuresis using mannitol and sodium bicarbonate is employed. However, this intervention should be applied cautiously due to the potential risk of patient dehydration [6, 27].

During the first 24 hours, hemodialysis is also effective, but its clinical utility is limited as patients rarely present to the hospital with symptoms within such a short timeframe [27]. Extracorporeal elimination is more commonly employed in children due to the faster onset of symptoms and more severe course of poisoning, leading to earlier hospitalization in this patient group.

Pediatric patients are particularly vulnerable to severe mushroom poisoning. In the general statistics, mushroom intoxications account for approximately 4–6% of all poisoning cases reported to the Toxicological Information Bureau in Warsaw [28]. This type of poisoning is most common in children under 5 years of age [29]. It seems reasonable, therefore, to completely avoid serving mushroom-based dishes to young children.

The main prognostic factors in cases of mushroom intoxication, apart from the species of mushroom consumed, include the presence of amanitin in blood serum and/or urine, an increase in liver and kidney function markers (ALT, AST, INR), timely implementation of targeted treatment, and coexisting diseases and concurrent medications, especially drugs responsible for inducing cytochrome P450 or depleting glutathione reserves [7, 22, 23].

In cases of mushroom poisoning, the risk of toxic damage to the liver and kidneys is always present. It is often difficult to determine the exact dose of mushrooms ingested by the patient. Furthermore, it is frequently unknown whether the patient was concurrently exposed to other hepatotoxic or nephrotoxic agents [6, 23, 30].

The demographic structure of mushroom poisoning indicates a higher proportion of residents from small towns and rural areas compared to urban populations. This is likely due to easier access to forested areas in these regions.

Conclusions

Mushrooms have long held an important place in both culinary tradition and the pharmaceutical industry. However, mushroom foraging can be risky due to misidentification, leading to poisoning. While the number of hospitalizations related to mushroom poisoning has decreased in recent years, the risk remains, particularly for those unfamiliar with safe foraging practices.

To prevent poisoning, it is crucial to collect only well-known mushroom species, thoroughly inspect gathered mushrooms (especially those collected by children), and avoid collecting gilled mushrooms or immature specimens. Public awareness campaigns have contributed to fewer people collecting unknown mushroom species. Additionally, proper mushroom storage and professional packaging with clearly marked expiration dates further reduce the risk of consuming spoiled or poisonous mushrooms.

The growing popularity of hallucinogenic mushrooms poses a new risk, especially among young people. Therefore, comprehensive education on the dangers of these mushrooms is essential for adolescents, parents, and educators.

While the sale of fresh, dried, and packaged mushrooms is carefully monitored by the State Sanitary Inspection, fostering a preference for cultivated mushrooms from trusted sources can further reduce poisoning incidents [31]. Ultimately, the goal is to emphasize the importance of caution during mushroom foraging and to promote the consumption of safe, cultivated mushrooms with similar culinary qualities.

References

1. Panasiuk L. Zatrucia grzybami. Medycyna Rodzinna, 1999; 2: 41–48
2. Ciećkiewicz J. Zatrucia grzybami. Medycyna Praktyczna, 2008. https://www.mp.pl/pacjent/pierwsza_pomoc/74676,zatrucie-grzybami (access: 17.07.2023)

3. Morawiec A. Magiczny świat grzybów w kulturze ludowej. Małopolski Ośrodek Doradztwa Rolniczego z siedzibą w Karniowicach, 29.04.2021. https://modr.pl/nasz-dom/strona/magiczny-swiat-grzybow-w-kulturze-ludowej (access: 17.07.2023)
4. Spencer DM. Mushroom, its history and importance. In: Flegg PB, Spencer DM, Wood DA, eds. Biology and technology of the cultivated mushroom. John Wiley & Sons, Chichester, New York, 1985: 1–8.
5. Gawlikowski T, Bilska-Kos A, Satora L. Zatrucia grzybami jadalnymi. Państwo i Społeczeństwo 2018; 3: 119–131. doi: 10.31749/pismzp2018/20850
6. Ferenc T, Łukasiewicz B, Ciećwierz J, Kowalczyk E. Zatrucia muchomorem sromotnikowym (*Amanita phalloides*) Medycyna Pracy 2009; 60: 415–426
7. Pawłowska J, Pawlak J, Kamiński A, et al. Zatrucie muchomorem sromotnikowym jako wskazanie do transplantacji wątroby u trzech członków rodziny. Wiad Lek, 2006; 59: 131–134
8. Kotwica M, Czerczak S. Acute poisonings registered since 1970: trends and characteristics. Analysis of the files collected in the National Poison Information Centre, Łódź, Poland. Int J Occup Med Environ Health, 2007; 20: 38–43. doi: 10.2478/v10001-007-0010-8
9. Marciniak B, Ferenc T, Kusowska J, et al. Zatrucia wybranymi grzybami o działaniu neurotropowym i halucynogennym. Medycyna Pracy, 2010; 61: 583–595.
10. Beaumier M, Rioult JP, Georges M, et al. Mushroom poisoning presenting with acute kidney injury and elevated transaminases. Kidney Int Rep, 2019; 4: 877–881. doi: 10.1016/j.ekir.2019.02.016
11. Kołaciński Z, Klimaszyk D, Szajewski J. Grzyby trujące. W: Gajewski P, red. Interna Szczeklika 2023. Kraków: Medycyna Praktyczna; 2023: 1574–1577.
12. Łukasik-Głębocka M, Naskręt M, Górny J. Podstawowe zasady dekontaminacji przewodu pokarmowego w ostrych zatruciach. Postępy Nauk Medycznych, 2010; 9: 718–722
13. Szajewski J. Ogólne zasady leczenia ostrych zatruć. Toksykologia dla nietoksykologów. Ostre zatrucia egzogenne. Medycyna Praktyczna 2008, https://nagle.mp.pl/biblioteka/158653,ogolne-zasady-leczenia-ostrych-zatruc (access: 18.08.2023)
14. Gumińska B, Wojewoda W. Grzyby i ich oznaczanie. Warszawa: PWRiL, 1985
15. Czarkowski M, Wielgosz U. Choroby zakaźne i zatrucia w Polsce w 2023 roku. Warszawa: Narodowy Instytut Zdrowia Publicznego PZH – Państwowy Instytut Badawczy; 2024. https://wwwold.pzh.gov.pl/oldpage/epimeld/2023/Ch_2023.pdf
16. Czarkowski M, Staszewska-Jakubik E, Wielgosz U. Choroby zakaźne i zatrucia w Polsce w 2021 roku. Warszawa: Narodowy Instytut Zdrowia Publicznego PZH – Państwowy Instytut Badawczy; 2022. https://wwwold.pzh.gov.pl/oldpage/epimeld/2021/Ch_2021.pdf
17. Czarkowski M, Niewęgłowska A, Szmulik-Misiurek K, et al. Choroby zakaźne i zatrucia w Polsce w 2019 roku. Warszawa: Narodowy Instytut Zdrowia Publicznego – Państwowy Zakład Higieny; 2020. https://wwwold.pzh.gov.pl/oldpage/epimeld/2019/Ch_2019.pdf
18. Czarkowski M, Cielebań E, Staszewska-Jakubik E, et al. Choroby zakaźne i zatrucia w Polsce w 2017 roku. Warszawa: Narodowy Instytut Zdrowia Publicznego – Państwowy Zakład Higieny; 2018. https://wwwold.pzh.gov.pl/oldpage/epimeld/2017/Ch_2017.pdf
19. Czarkowski M, Cielebań E, Staszewska-Jakubik E, et al. Choroby zakaźne i zatrucia w Polsce w 2015 roku. Warszawa: Narodowy Instytut Zdrowia Publicznego – Państwowy Zakład Higieny; 2016. https://wwwold.pzh.gov.pl/oldpage/epimeld/2015/Ch_2015.pdf
20. Wojewódzka Stacja Sanitarno-Epidemiologiczna w Krakowie, Kampania bezpieczny wypoczynek – grzyby trujące i jadalne. https://www.gov.pl/web/wsse-krakow/kampania-bezpieczny-wypoczynek---grzyby-trujace-i-jadalne (access: 17.07.2023)
21. Gumprecht K. Zatrucia. In: Bursa J, ed. Wybrane zagadnienia z intensywnej terapii dziecięcej. Śląska Akademia Medyczna, Katowice, 2006: 112–122
22. Gomółka E, Szpak D, Morawska A, et al. Oznaczanie amanityny w diagnostyce zatruć grzybami. Przegląd Lekarski, 2010; 67: 576–579
23. Mosakowska M, Wrzosek M, Wesołowski P, et al. Ostre cewkowo-śródmiąższowe zapalenie nerek w przebiegu zatrucia grzybami – prezentacja przypadku klinicznego. Nefrologia i Dializoterapia Polska, 2019; 23: 129–131
24. Łukasik-Głębocka M, Naskręt M, Łukasik A, et al. Diagnostyka zatruć grzybami w szpitalnym oddziale ratunkowym. Postępy Nauk Medycznych, 2010; 9: 736–740
25. Ganzert M, Felgenhauer N, Zilker T. Indication of liver transplantation following amatoxin intoxication. J Hepatol, 2005; 42: 202–209. doi: 10.1016/j.jhep.2004.10.023
26. Mas A. Mushrooms, amatoxins and the liver. J Hepatol, 2005; 42: 166–169. doi: 10.1016/j.jhep.2004.12.003
27. Tkaczyk J, Brożyna K, Radzka A, et al. Rodzinne zatrucie muchomorem sromotnikowym – opis dwóch przypadków w kontekście sytuacji epidemiologicznej regionu. Nauki Przyrodnicze, 2018, 2: 33–41
28. Burda P. Zatrucia ksenobiotykami u dzieci. Dziecko Krzywdzone. Teoria, Badania, Praktyka, 2005; 4: 86–94
29. Jackowska T, Grzelczyk-Wielgórska M. Ostre zatrucia jako przyczyna hospitalizacji dzieci i młodzieży w oddziale pediatrycznym – 9-letnia analiza. Postępy Nauk Medycznych, 2014; 27: 628–632
30. Kępczyński Ł. Zatrucie grzybami – mechanizmy toksyczności i postępowanie. Stany Nagłe po Dyplomie, 2019; 3
31. Główny Inspektorat Sanitarny. Stan Sanitarny Kraju w 2020 roku. Warszawa, 2021. https://medycynapracyportal.pl/wp-content/uploads/aktualnosci/2021/09/13/Stan_Sanitarny_Kraju_w_2020_roku.pdf (access: 17.07.2023)