

# MUSHROOM GROWING WITH INFORMATION SUPPORT AS OPPORTUNITY FOR THE DEVELOPING COUNTRIES

VOSTROVSKÝ V., JABLONSKÁ E.

## Abstract

*This article describes the possibility of the mushroom growing with information support in the developing countries. Mushrooms growing can be a big opportunity for the developing countries. Very suitable above all can be the oyster mushroom growing. The successful oyster mushroom growing in developing countries will need a reasonable information support. This support may be performed by combination of ELearning and expert systems among others. Such solutions can be used for example at consulting centres of developing countries for producing of the oyster mushrooms. These features are demonstrated at the example of the mushroom growing in China and Kenya.*

**Key words:** knowledge, expert system, eLearning, expert eLearning, developing countries, Oyster mushroom growing, waste management

## INTRODUCTION

Growing mushrooms can be a big opportunity for the developing countries. Very suitable above all can be the oyster mushroom growing. There are some special advantages of the mushroom growing in the developing countries:

- abundance of plant waste for the substrate (straw, corn cobs, bagasa, sawdust, crop stalks and other agricultural and forest waste can be used to grow mushrooms),
- mushroom growing can solve problem of the protein meals insufficiency and starvation,
- it can increase insufficiency of the job opportunities,
- expensive mechanisation could be compensated by cheap manpower.

The market for mushrooms continues to grow due to interest in their culinary, nutritional, and health benefits. They also show potential for use in waste management. Importance of the mushrooms is following:

- Mushrooms have good nutritional value.
- Mushrooms provide high levels of protein, minor elements, vitamins and amino acids (white button mushrooms, for example, contain more protein than kidney beans.
- Mushrooms are the unique health food. Most of them have natural anti-viral and immunity-boosting properties that are used to fight viruses, lower cholesterol and regulate blood pressure.
- Mushrooms are ecologically important. Mycelium in substrate is active in remediation of contaminated soils.

These opportunities can be demonstrated on the oyster mushroom growing in China. The mushroom cultivation in China has a long-lasting tradition. Mushrooms have been grown there for hundreds of years. It utilizes reserves of cheap labour, sufficiency of the matter for substrates and popularity in the Chinese

board. The following table and graphs illustrate the mushroom growing level in China:

Mushroom growing can be a valuable method used to fight poverty and starvation. It can make agriculture more efficient and make money for farmers. For example there was realized a project in 1989 to help people in poverty stricken areas of China learn how to grow mushrooms for self-supply. In Shouling county in Fujian, there were many people living below the poverty line. 94% of the families were involved into the project. Since then, mushroom cultivation in that county has become more and more economically significant. The inhabitants are now emerging from extreme poverty (Oei, 1996).

Another proof of the economic potential of mushroom growing on developing countries is project in oyster mushroom production targeted for small-scale farmers in Kisumu (Kenya 2004). In March 2005, a demonstration on oyster mushroom production and processing was conducted in Busia and attended by 250 participants. Mary Kariaga, who participated in this project, produced 120 kg of oyster mushroom in a small room making a profit of KSh 37,630 (i. e. 5000 \$) in only three months (Giarratano, Riley, 1998).

## MATERIAL AND METHODS

Mushroom production is on the other hand labour and expertly intensive. It requires a considerable amount of knowledge, research, planning and capital investment to set up a production system. The main disadvantage of the oyster mushroom growing in the developing countries is the lack of the necessary information resources.

The oyster mushroom growing can be complicated by the following factors:

### Bacteria

The most common bacterial problem encountered by growers is *Pseudomonas tolaasii*. Infected mushrooms have a reduced shelf life. Lowering r.h. to 80 to 85 percent, and sprinkling the surface of the bags between flushes with 0.2 percent bleach solution may help maintain control.

### Fungii

Most fungi encountered in oyster mushroom production grow and develop on the substrate and are very rarely parasitic.

### Deformed fruit bodies

Deformed mushrooms may result from several causes, many of them still unknown. However, most deformed mushrooms may be traced to insufficient light and ventilation, chemical vapours and overheated substrate during spawn run.

### Airborne spores

A single mushroom may produce up to 4 million spores per hour. Inhaled spores can cause an allergic reaction in some growers (Oei, 1996). New developed sporeless strains can solve that problem.

The growers need the appropriate information and knowledge to solve these problems. The successful oyster mushroom growing in developing countries will need a reasonable information support. This support may be performed by combination of ELearning and expert systems among others.

### E-learning

E-learning is an effective use of information technologies (IT) in personal training process. It is available over the Internet, intranets, extranets (online) or CD and DVD (offline). It can support traditional learning and can be sometimes cheaper and faster (Kontis, 2007). This part of the proposed information support for oyster mushroom growing can make accessible the necessary information to users.

ELearning has some advantages and disadvantages over traditional teaching. There are some advantages:

- E-learning course is not only text and pictures transformed to electronic form. Through a number of multimedia objects (video, sound, simulation) can be learning more understanding.
- In less developed countries with less literacy is possible to use more speech, pictures and video.
- It is not necessary to start this course for a number of students – students can work individually.
- Students can study when they need it and when they are able to concentrate.
- Student has own pace of study.
- Student can review course or its part.
- Teachers do not waste time in repeating the same lectures in classes.
- Questions and tests are important part of eLearning course – through a number of questions,

simulations and tests students are getting involved in the training which significantly increases their capability to remember things (Kontis, 2007).

- Courses can be updated, extended and modified very easily.

E-learning requires other money investing to create courses, implement management system etc. There are special Learning Management Systems (LMS) for supporting e-learning (WebCT, LearningSpace, Moodle etc.), but it is not necessary to use LMS. PowerPoint is the very popular tool for building e-learning courses. It is used as a powerful and efficient e-learning development environment.

The eLearning main disadvantage is that the user has to have the access to computer. For example, the latest estimates indicate that Kenya has Internet penetration of 4.4%, more than 1000 cyber cafes, computer penetration of 2%, television penetration of 60% and mobile phone penetration of 16% (MIT Media Laboratory, 2007). However, this situation moves forward. This disadvantage can be solved by building-up of training centres in the developing countries.

The following initiative can solve this problem. Media Lab of the Massachusetts Institute of Technology, along with the World Bank, plans to provide a \$100 laptop to many millions of users in developing countries. It is also a huge responsibility, to make sure that the initiative really does help users to learn, in ways that are matched to their needs, interests and cultures (MIT Media Laboratory, 2007). The computer technology will not be sufficient, if the appropriate information resources will not be accessible as well.

The increasing importance of the eLearning in developing countries can be documented by 2<sup>nd</sup> International Conference on ICT for Development, Education and Training, Nairobi, Kenya May 2007. Meeting the networking needs of the Pan-African eLearning and distance education sector, the annual eLearning Africa conference (eLA) is the key networking venue for practitioners and professionals from Africa and all over the world. There are main facts: eLA is the largest gathering of eLearning and distance education professionals in Africa, enabling participants to develop multinational and cross-industry contacts and partnerships, as well as to enhance their knowledge, expertise, and abilities (eLearning Africa, 2007).

### Expert systems

The second component of the proposed solution creates an expert system. Expert systems are part of general category of computer applications known as artificial intelligence. An expert system is a class of computer programs developed by researches in artificial intelligence during the 1970s and applied commercially throughout the 1980s. In essence, they are programs made up of a set of rules that analyze information (usually supplied by the user of the system) about a specific class of problems, as well as provide analysis of the problem(s), and, depending

upon their design, recommend a course of user action in order to implement corrections (Quimio, Chang, 1990). The expert systems have enhanced productivity in business, ecology, medical diagnosis, social sphere and the military. These systems can be applied for the oyster mushroom growing as well.

The typical expert system consists of

- knowledge base,
- inference engine and
- explanation facilities.

The knowledge base is the most important part of the whole solution, which implicates his total quality. This base contains the knowledge with which the inference engine draws conclusions (Giarratano, Riley, 1998). The basic scheme of a proposed solution is shown in Fig. 4. The expert systems are usually designed to have the following general characteristics:

- **High performance.** The system must be capable of responding at a level of competency equal to or better than of an expert in the field.
- **Adequate response time.** The system must also perform in a reasonable amount of time, comparable to or better than the time required by an expert to reach a decision.
- **Good reliability.** The expert system must be reliable and not prone to crash or it will not be used.
- **Understandable.** The system should be able to explain the steps of its reasoning while executing so that it is understandable (Holsapple, Whinston, 1996).

Expert system, as a component of the proposed information support, enables expert consultation of the oyster mushroom growing problems to its users. To illustrate such expert consultation we will suppose the following knowledge:

**If** the fruit bodies of the oyster mushrooms are miss formed, the fruit bodies have the long stipes and dwarfed huts and they look like on the picture, **then** cause is insufficient illumination of culture during fruit bodies' development.

The following rule will correspond with the above mentioned knowledge:

IF the fruit bodies of the oyster mushrooms are miss formed

AND the fruit bodies have the long stapes

AND the fruit bodies have dwarfed huts

AND they look like on the picture

THEN cause is insufficient illumination of culture during fruitbodies' development.

The expert consultation of the proposed solution is shown in Fig. 6. The user can be relocated into theoretical part of the eLearning application for more detailed information relating to the found solution.

## CONCLUSION

The process of the oyster mushrooms growing in developing countries can be complicated by number of the problems. To solve these problems needs the

appropriate information support. Proposed conception of expert ELearning information support should provide to its users:

- o long time education,
- o all time information resource,
- o expert consultation of the practical growing problems.

The proposed information support of the oyster mushroom growing has the following benefits:

- the availability of the saved information and knowledge,
- the lucidity of the saved information and knowledge,
- the efficient forwarding of the knowledge independent on the human subject,
- more visual presentation of the saved information by means of the multimedia components,
- more efficient way of the information and knowledge forwarding independent of the space, time and subject.

## ACKNOWLEDGEMENT

This paper was supported by the research project of the Czech Ministry of Education No. MSM 6046070904 and No. 2C06004.

## REFERENCES

- eLearning Africa: <http://www.elearning-africa.com>  
 Formatkenya: <http://www.formatkenya.org/report2004/format2004>  
 Giarratano J., Riley G. (1998): Expert systems – principles and programming, PWS Publishing Com-pany, Boston.  
 Holsapple C.W, Whinston A.B. (1996): Decision Support Systems: A Knowledge-based Approach. West Publishing Co., Minneapolis, MN.  
 Jablonský I., Šašek V. (2006): Jedlé a léčivé houby. Brázda, Praha.  
 Jablonský I. (2007): Personal communication <http://sweb.cz/i.jablonsky/zampiony>.  
 Kontis: [http://onlinelearning.kontis.net/uvod\\_prinos.asp](http://onlinelearning.kontis.net/uvod_prinos.asp)  
 MIT Media Laboratory: <http://laptop.media.mit.edu/>  
 Oei P. (1996): Mushroom cultivation with special emphasis on appropriate techniques for developing countries. Tool Publ., Amsterdam.  
 Quimio T.H., Chang S.T., Royse D.J. (1990): Technical Guidelines for Mushroom Growing in the Tropics. FAO Plant Production and Protection Paper 106, Rome, Italy.  
 Internet World Stats <http://www.internetworldstats.com>  
 Wikipedia: [http://en.wikipedia.org/wiki/expert\\_system](http://en.wikipedia.org/wiki/expert_system)

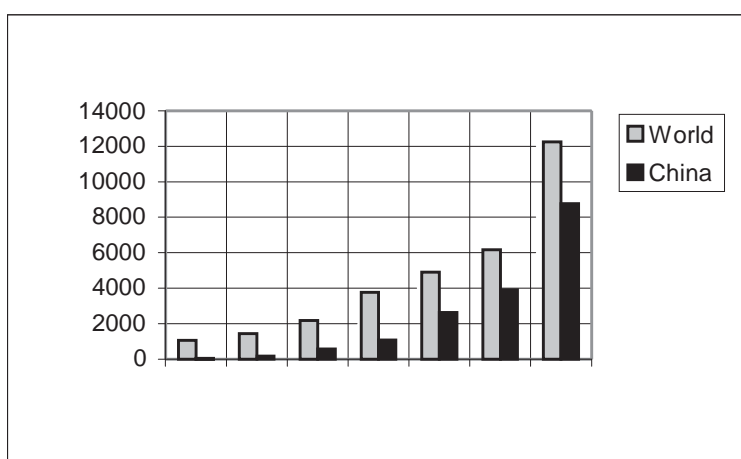
*Received for publication on June 20, 2007  
 Accepted for publication on October 15, 2007*

**Tab.1:** Mushroom production in China (2002) (Jablonský, 2007)

Species	Amount (tons)
<b>Pleurotus</b> (oyster mushroom)	2 488 000
<i>Lentinula</i>	2 228 000
<i>Aricularia</i>	1 654 000
<i>Agaricus</i>	1 330 000
<i>Volvariella</i>	197 000
<i>Flammulina</i>	557 000
<i>Tremella</i>	183 000
<i>Hypzisticus</i>	242 000
<i>Pholiota nameko</i>	171 000
<i>Coprinus</i>	177 000
<i>P. eryngii</i>	114 000

**Tab.2:** World Internet usage and population (Internet World Stats, 2007)

World Regions	Population (2007 Est.)	Internet Usage, Latest Data	% Population (Penetration)	Usage % of World	Usage Growth 2000–2007 (%)
Africa	933,448,292	33,421,800	3.6	2.9	640.3
Asia	3,712,527,624	409,421,115	11.0	36.0	258.2
Europe	809,624,686	319,092,225	39.4	28.2	203.6
Middle East	193,452,727	19,424,700	10.0	1.7	491.4
North America	334,538,018	230,987,282	69.0	20.4	113.7



**Fig. 1:** Comparison of production in China and in the world (Jablonský, 2007)



Fig. 2: Picture of \$100 laptop for developing countries (MIT Media Laboratory, 2007)

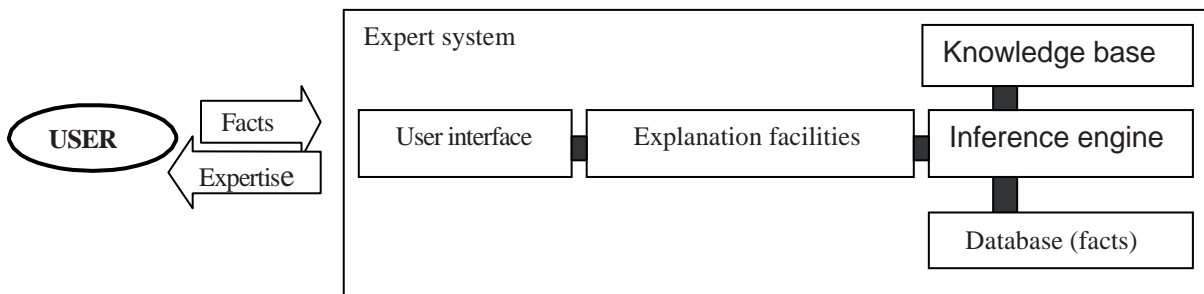


Fig. 3: Basic scheme of a typical expert system

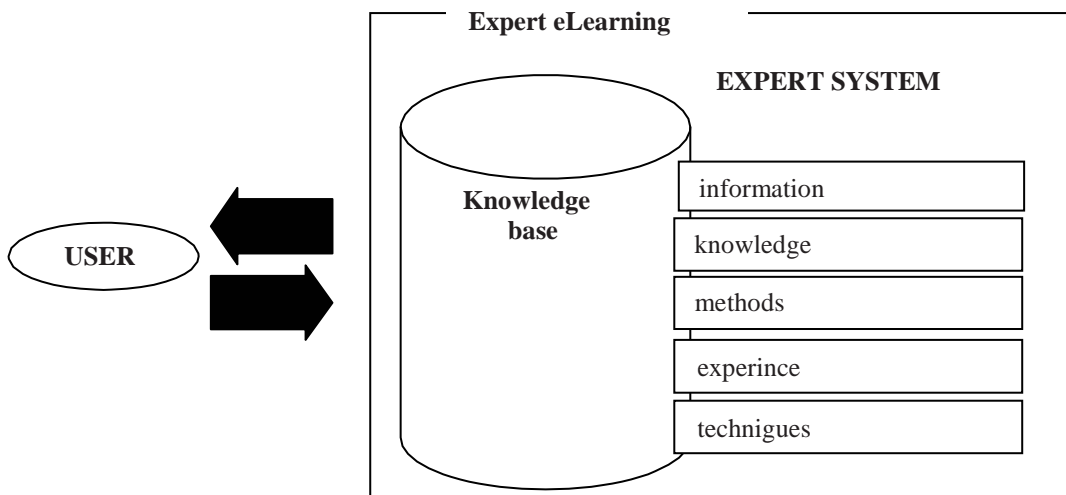


Fig. 4: Basic scheme of a proposed solution



Fig. 5: The realized prototype of the expert eLearning for the oyster mushroom growing

**System:** Are the fruit bodies of the oyster mushrooms miss formed?

**Answer of user (mushroom grower):**


**System:** Have the fruit bodies the long stipes?

**Answer of user (mushroom grower):**

**System:** Have the fruit bodies dwarfed huts?

**Answer of user (mushroom grower):**

**System:** Do they look like on the picture?



**Answer of user (mushroom grower):**

**System:** I conclude: cause is insufficient illumination of culture during development of fruit bodies.  
 Recommendation: Measure intensity of illumination and regulate its corresponding intensity.

Fig. 6: Example of the expert consultation of the oyster mushroom growing problems

Corresponding author:

**Dr. Ing. Vostrovský V.**  
 Czech University of Life Sciences Prague  
 Faculty of Economics and Management  
 Department of Information Engineering  
 165 21 Prague 6-Suchdol, Czech Republic  
 vostrovsky@ pef.czu.cz

