

MUSHROOM

PREFACE

Caught by the mushroom virus in 2002 and later working for Vihiga Mushroom Project (VIMPRO) and Kenya Mushroom Growers Association (KEMGA), we decided to write a practical book based on Kenyan case study which might as well prove applicable to the whole of Africa.

Mushroom production was introduced into the country in 1969.

However, its cultivation has been hampered by lack of information, extension, research and reluctance of those in possession of skills to share with interested parties. We hope that this book will activate the latent demand in mushroom production and consumption.

Acknowledgement

We acknowledge effort the Ministry of Agriculture Vihiga District did in the promotion of mushroom production in the district and as a result the whole country has seen the importance of mushroom cultivation. Our sincere gratitude goes to the District Agricultural Officer Ms Flora Musanga for her tireless support towards mushroom promotion and editing of this important book, the former District Crops Officer Mr. Jackson Mbato for his introduction of the crop in the district, Mr Walter Musoga, Joyce Agesa and Geoffrey Opondo who by then were crops officers in Vihiga district for their personal support in backstopping services in production, processing and value addition. We also congratulate farmers in the district for embracing the concept with a positive approach which saw the formation of an umbrella organization known as Vihiga Mushroom Project (VIMPRO) to undertake mushroom cultivation as a business to uplift their livelihood.

We do appreciate the roll played by GTZ— Private Sector Development Agencies (PSDA) to have facilitated the capacity building in terms of spawns production, mushroom production, processing and value addition of mushrooms.

Dr Michael Osoro a Plant pathologist and Mycologist of Baraton University and Daniel Rotich of KARI— Kakamega research centre cannot be forgotten for the provision of technical information in mushroom cultivation. They also edited the book.

Last and not list is my wife Irene Kahuga Okwemba for her moral support in the writing and production of this book. I would also like to acknowledge the encouragement from my son Josiah Sagini. I also give my thanks to Felix Asenji Silingi for having taken time for typesetting and designing the book despite his tight schedules of studying for his degree in Industrial Chemistry.

INTRODUCTION

Mushroom History

The first professional growers of mushrooms were the Chinese. As early as 1313, a document was published which described the cultivation method for Shiitake on wood logs.

Even older is the cultivation of the wood ear mushroom (*Auricularia* spp) of which sources indicate that it was cultivated from the year 600 A.D. onwards.

The white button mushroom, *Agaricus bisporus*, was domesticated in France. The first descriptions date from 1707 and the technology was based on the fact that composted manure which produced mushrooms could be used to inoculate new stacks of composting horse manure.

At the end of the 19th Century a multi-store technique for spawn was developed in France, followed by tissue culture techniques by American Dugger.

The narcotic and hallucinogenic properties of certain mushrooms have been known since ancient times. Some mushrooms were even regarded as sacred, and in some cultures their use was prohibited to ordinary people.

Mushroom (s) are fleshy fungi, spore-bearing fruiting bodies of typically produced above ground on soil or on their food sources which constitute a major group of lower plant kingdom. Mushrooms often refer to fruiting body of the gill fungi. They do not contain chlorophyll like green plants and as a result cannot manufacture their own food. In this respect they are like animals because they feed themselves by digesting other organic matter. The use of mushrooms as food is very old. People have harvested mushrooms from the wild for thousands of years for food and medicine. The Egyptians regarded them as food for pharaohs. The Greeks and Romans described them as food for gods and were served only on festive occasions.

Mushrooms contain many essential amino acids, proteins, carbohydrates, unsaturated fatty acids, fibre and minerals. The popularity of mushrooms in the diets of many people in the world continues to increase at the same time, interest in growing gourmet mushrooms..

Over 200 species of mushrooms have been collected from wild for various traditional medicinal purposes mostly in the Far East. The majority of the cultivated species are both edible and possess medicinal properties: Overall world production of mushrooms is increasingly being dominated by species that are both edible and have medicinal properties. China is a major producer and consumer of both edible and medicinal mushrooms. Overall, the world production of cultivated edible and or medicinal mushrooms was recorded as 4,909,000 in 1994, increasing to 6,158,000 tons estimated at 14 billion US dollars.

There is evidence to show that some species of mushrooms contain powerful stimulants of the immune system. Numerous studies have demonstrated the anti-cancer and interferon stimulating properties of *Lentinula edodes* (Shiitake mushroom). Mushrooms reduce Serum cholesterol levels significantly after eating mushrooms for a week. It has also been shown that shiitake mushrooms have anti tumour influence. Mushrooms also stimulate interferon development.

With the current emphasis on prevention and natural cures for human diseases, mushrooms are proving to be convenient, inexpensive and an effective method of sustaining good health.

Small scale mushroom production represents an opportunity for farmers interested in an additional enterprise, and is a special option for farmers without much land. Agricultural waste materials, such as sugarcane Bagasse, wheat and rice straws, bean and soya bean stalks, maize stovers, banana pseudo stems and many others, are excellent growing media for edible mushrooms. Mushroom cultivation can play an important role in managing farm organic wastes when agricultural and foods processing by products are used. The spent mushroom substrate (SMS) can then be applied directly to the soil or fed to livestock.

Animal protein is beyond the reach of many low income groups which constitute a large proportion of Kenyans. Malnutrition in terms of protein deficiency is one of the major factors responsible for high mortality and morbidity in Kenya. Sustainable mushroom production in Kenya can reduce levels of malnutrition significantly. The protein content of fresh mushrooms is about 3.7% while in dried mushrooms it accounts up to 35%. It is twice as high as that of any vegetable except soya beans.

There is therefore need to conduct research and incorporate mushroom production into the farming system.

What is a mushroom?

A mushroom is a fleshy fungi, spore-bearing fruiting bodies of typically produced above ground on soil or on their food sources fruiting body of fungi.

Its botanical name is *Basidiomycota*, **Agaricomycetes** that have a stem (called) a stipe), a cap (called a pileus), and gills (each called a lamella/plural lamellae) on the underside of the cap just as do store-bought white mushrooms. However, mushrooms can also be a wide variety of gilled fungi, with or without stems and the term is used even more generally to describe both fleshy fruitbodies of some Ascomycota and woody or leathery fruit bodies of some Basidiomycota, depending upon the context of the usage. Usually forms deviating from the standard form have more specific names, such as puffballs, stinkhorn, morels etc and gilled mushrooms themselves are often called agarics in reference to their similarity to *Agaricus* or placement in the order Agaricales.

By extension, *mushroom* can also designate the entire fungus when in culture or when referring to the whole thallus (called a mycelium) of species forming fruit bodies called mushrooms.

Mushrooms vs. Toadstools

The terms “mushrooms” and “toadstools” go back centuries, and were never precisely defined, nor there consensus on application, except to say that the term “toadstool” was generally, but not exclusively applied to poisonous fungi. Reference was made to “tad stoles”, “frogstoole”, “froggestoles”, “tadstoole”, “tode stoles”, “toodys hatte”, “loaddstoole”, “paddockstool”, “paddocsol”, “toadstoole”, and “puddockstoole” from 1398-1597, sometimes synonymous with “mushrom”, “muschrum”, “muscheroms”, “mousheroms”, or “muserouns”.

The term “mushroom” and its variations may have been derived from the French word “Mousseron” in reference to (mousse). There may have been a direct connection to *toads* (in reference to poisonous properties) for toadstools.

However, there is no clear-out-cut delimitation between edible and poisonous fungi, so that mushrooms may be edible, poisonous, or unpalatable, and it makes no sense to not be able to use the term mushroom when stating there are “poisonous mushrooms” which would be an oxymoron statement if the term mushroom would not be applied to poisonous fungi. The term toadstool is nowadays used story telling when referring to poisonous or suspect mushrooms. The classic example of a **toadstool** is *Amanita muscaria*.

Identification of Mushrooms

Identifying mushrooms requires a basic understanding of their macroscopic structure. Most are *Basidiomycetes* and gilled. Their spores, called *basidiospores* are produced on the gills and fall in a fine rain of powder from under the caps as a result. At the microscopic level the *basidiospores* are shot off of *basidia* but then fall between the gills in the dead air space. As a result, for most mushrooms if the cap is cut off and placed gill-side down, usually overnight a powdery impression reflecting the shape of the gills (or pore, or spines, etc) is formed (when the fruit body is sprouting). The colour of the powdery print (which is called a *spore print*) has been used to help classify mushrooms, hence is used to help identify them.

Fungi are among unicellular, multi-cellular, non-photosynthetic organisms and therefore they cannot manufacture their own food. They rely on decaying matter or other plant organisms for organic compounds for their nutritional requirements. Their growth is sudden and rapid. These include moulds, yeast, mushroom and toadstools. Lower fungi have yielded important medicines like penicillin and other antibiotics from penicillin (a common contaminant in mushroom cultivation).

In China it is estimated that more than 700 medicinal products with mushrooms as the main ingredient are commercially available. Asian traditions maintain that some specialty mushrooms provide health benefits. Chinese doctors use at least 50 species.

The food materials sought encompass

- Glucose and starch
- Cellulose and lignin

Types of Mushrooms

There are several types of mushrooms. However; it is found that there are those that are edible and non-edible ones.

Our minds will now zero down to the edible ones which include:-

- a) Button - Agaricus
- b) Oyster - Pleurotus
- c) Shiitake - Lentinula Edodes
- d) Straw - Volvullella volvacea
- e) Chinese mushroom - Ganoderma
- f) Termitomyces

They also show potential for use in waste management. The choice of species to raise depends both on the growth media available and on market considerations. Oyster mushrooms, which grow on many substrates, are easiest for a beginner. Oyster mushroom cultivation has one significant drawback: some people are allergic to the spores. In these cases, air-cleaning equipment or respirators are necessary in order to safely work in the production facility.

The consumer market for oyster mushrooms is being developed by the larger mushroom companies as they diversify their operations. However, because of the short shelf life of many oyster mushroom varieties, this species may offer a special advantage to the local grower who markets directly and can consistently deliver a fresh, high-quality product. Shiitake mushrooms already have earned considerable consumer demand. Only two mycorrhizal mushrooms, morels and truffles, have been commercially cultivated. Mushroom cultivation offers benefits to market gardens when it is integrated into the existing production system. A careful analysis of potential markets must be the first step in deciding whether to raise mushrooms to sell. Many information resources are available for further research.

Every year thousands of tons of agricultural waste is discarded, burned and neglected. In the process of mushroom cultivation, however, the resultant environmental pollution may be reduced.

Since mushroom is a good degrader of cellulose and lignin, the spent compost is used as a soil conditioner. Studies reflect that mushroom composts give comparable or higher yields of a wide range of vegetables.

The type of mushrooms we grow i.e Pleurotus spp. (Oyster) is classified as white rot basidiomycetes. These share the ability to degrade lignin and cellulose, major constituents of plant material. Lignin and cellulose are difficult to degrade, as are a number of xenobiotic pollutants. The structure of lignin is similar to that of PAHs (poly aromatic hydrocarbons) consisting of benzene rings linked with carbon and hydrogen atoms in linear, angular or clustered arrangement. A beneficial aspect of mushrooms is that they are able to break down organic pollutants like PCB, PAH and dioxins. Bacteria have already been used for remediation of gasoline containing soils.

They manage to break down some PAHs but they cannot degrade PAHs with more than four benzene rings. This is due to the very low water solubility of the more complex PAHs. The pollutants strongly adhere to organic substances and are difficult to reach for the bacteria.

The mycelium of white rot basidiomycetes works quite differently. It produces extra cellular enzymes which can reach non-soluble pollutants, even if these adhere to humus substances.

Therefore the use of agricultural waste is a positive aspect of mushroom growing:-

- Coffee pulp creates environmental stress because it is often dumped in rivers and lakes. If it is used to grow mushrooms first, it would serve as a good soil conditioner.
- Water hyacinth is a major pest in lakes. By removing it from the lakes to serve as substrate for mushroom growing, both wildlife in the lake and farmers benefit

- Apart from being a fire risk in sugar factories and plantations, sugarcane bagasse is a major cause of pollution. If it can first be degraded by growing mushrooms it can serve as a soil conditioner and also an extra source of income to farmers in the sugar belt.

Benefits from Mushrooms

a) Nutritional Value

i) Protein

Protein content of dry weight is between 19% and 35%

ii) Fat

Low rate of fat content between 1-8%

The high content of linollic acids is one of the reasons why mushrooms are considered healthy food.

iii) Vitamins and minerals

Mushrooms are a good source of vitamins such as thiamine (Vitamin B).Riboflavin (vitamin B₂), niacine, biotine and ascorbic acid (vitamin C), folic acid.

They also contain significant amounts of phosphorus, sodium, potassium, calcium, magnesium, iron and Zinc.

b) Medicinal Value

i) Heart and coronary diseases.

Lower fungi have yielded important medicines like penicillin and other antibiotics from penicillium (a common contaminant in mushroom cultivation). Mushrooms contain substances which lower the cholesterol level in serum and liver which makes it good for those suffering from heart diseases.

ii) Cancer

Many mushrooms contain substances, which suppress the growth rate of tumours.

iii) Diabetes

Research in animals indicates that mushrooms like pleorotus ostreatus

(Oyster), cord caps, saneness, lentinula edodes and grifola frondosa have a positive effect on diabetes.

iv) Protection against free radicals and infection.

Free radicals can damage body cells and induce cancers. Free radicals are the result of specific transformation process. Many bio active compounds protect the body against these radicals. These substances are often called anti oxidants and are present in many mushrooms. In other words, the body immunity is boosted. This will be a relief to those suffering from HIV/AIDS

GANODERMA MUSHROOM

GANODERMA (LINGZHI)-A Magic,

Herbal Medicine

For thousands of years *Ganoderma* has been considered by the Chinese to be a high quality herbal medicine. The so called A-One Medicine is the best medicine which does not have any side effects, even after using for a long time. It can improve ones constitution, increase the body healing ability, to help maintain healthy body and have a long life.

The outline Of Herbal Medicine, Written by a very famous Chinese pharmacologist Dr. Li Shin-Chen. Classifies Ganodermas into six categories, by color. They are Black Ganoderma, purple Ganoderma, Blue Ganoderma., White Ganoderma, Yellow Ganoderma. Red Ganoderma.

Successful Cultivation:

Wild Ganoderma is very rare and is difficult to collect, Even if someone finds it by chance, its effects are always lost because of aging. It becomes hard like leather. They may also toxic. Since they are haphazardly collected, quality control is impossible.

In 1970, a technician of Kyoko University Foodstuff Scientific Research Institute Mr. YuKio Naoi, used, Spore Separation Cultivation method to successfully cultivate Ganoderma. This method was introduced in the Republic of china in 1975. Since the climate and soil conditions are ideal, this technique has been widely adopted there.

The Magic Effects of *Ganoderma*:

Ganoderma has always been shrouded with a mysterious curtain for more than thousand years, people only know, *Ganoderma* can keep one young and give one a long life if taken continuously, but no one had ever scientifically investigated why it is so effective.

Under the attentetive research done by both Chinese and foreign scholas in recent years and the cooperative anylysis and clinical experiments done by the hospitals, colleges, and pharmaceutical manufacturers, its extensive efficacy has finally been discovered It is a hermocatharsis, detoxicant, diuretic, liver protector, Intestine regulator, cardio tonic. Blood pressure adjustor, a cold tonic, anitussive and expectorant, a tranquilizer an anti-tumor drug.

Important components of *Ganoderma*

1. Organic Germanium (Ge) can increase the oxygen absorbed by the blood up to 1.5 times: can promote metabolism: prevent tissue degeneration: According to the research of Dr. kazuhiko Asai. Ganoderma contains 800-2000p.p.m of gemanium. This is 4.6 times more than ginseng.
2. Polysaccharides: These can improve the body's immune system. Eliminate viruses. Japanese pharmaceutical companies have refined it to medical quality and it has approved by the Koisho Health Department in Japan for insurance medicine.
3. Its bitter taste. It is under constant study by the Japanese medical and pharmaceutical fields. The efficacy is a result of the interrelation of germanium and polysaccharides. Some plants may contain one or the plants and all of the components must be preserved to insure efficiency

Medical principles of *Ganoderma*:

According to Dr. shigeru Yugeru Yuji clinical experiments, the reason *Ganoderma* is effective is because of its basic functions.

1. Lowers cholesterol in the blood and the amount of free fat
2. Reduces blood sugar level; to restore pancreas functions
3. Lowers blood lipids and stabilizes red cell membrane.
4. Due to *Ganoderma* contains Adenosine it can lower platelets angulations, and lyse thrombi and prevent thrombogenesis
5. Improves the function of the Cortes of the adrenal glands to maintain endocrine balance.

6. Elevates the natural healing ability of the body, allow the body to established a strong immune system.
7. Prevent tissue cell degeneration.
8. Prevents senility. Maintaining a youthful constitution.
9. Lowers the side effects of antihypertensive drugs.
10. Prevent organ degeneration.
11. Prevents allergy caused by antigens, because it inhibits the amine releasing mast cell.
12. Prevents and treats cancer and inhibits cancer cell metastasis.
13. Normalizes to prevent tissue degeneration
14. Prevents sudden death of cancer patients caused by embolism.
15. Inhibits thrombogenesis and lyses thrombi on the wall of surrounding tissue and removes blockade of cancer medication, Increases these drugs effectiveness.
16. Relieves pain caused by cancer.

Is it really true that Ganoderma is the saviour of modern diseases and is a Universal Medicine for all diseases?

By Yukio Naoi of Kyoto University Foodstuff Scientific Institute

Is Ganoderma really a universal medicine? Lets not talk about the diseases prevalent in history, but of modern diseases. In order to find the answer. We have investigated its functions over and again for thirteen years satisfactory results have been obtained.

The first issue is whether Ganoderma can be effective on all kinds of diseases. Our reply is yes because it is able to maintain the health of the modern people: Ganoderma has an effective all the same. People all over the world will obtain the same results.

If the patient's constitute conforms to Ganoderma, it is as if a patient drug is achieving its highest effects. In fact, we have not found any person who obtained negative effects or inefficient results.

Some outstanding results obtained recently are simply analyzed below, in order to evaluate the efficacy of **Ganoderma**.

Headache and shoulder pain caused by hypertension and arteriosclerosis are completely cured, and blood pressure also improved. Reported by Mr. Isao Tani of the medical research Institute of Kinki University.

The experimental subjects were predominantly hypertension patients. Blood pressure showed significant improvement is rarely seen without using antihypertensive.

Some female arteriosclerosis patient's blood pressure dropped to 128/67 from 158/77. Within three month. Their cholesterol level also improved from 269 to 242.

Some patients have hypertension with headache and shoulder pain. Their blood pressure dropped from 151/78 to 118/72 in one month, and headaches were eliminated

Of a number of patients who had blood pressure and pain problems, both conditions improved

Based on the above results, we may see that Ganoderma is useful to hypertension patients; using an anti-hypertensive to lower blood pressure can lower the systolic pressure, but the diastolic pressure Ganoderma can lower both. This is its outstanding quality.

2. Why is it effective for both systolic pressure and diastolic pressure?

Dr. Shigere Yuji of Kinki University gives six explanations why Ganoderma is effective for cardio-vascular diseases:

- b. Treats hypertension.

- c. Elevates blood pressure of hypertensive patients.
- d. Prevents arteriosclerosis, lowers cholesterol level
- e. Prevents thrombogenesis and dissolves thrombi.
- f. Reduces the side effects of antihypertensive.
- g. Used together with antihypertensive it may cause a hypertensive effect.

Cancer, sudden death and vascular obstruction diseases and threatening no more.

Figure: Cross-section of blood vessel: progress of arteriosclerosis.

3. It is effective in treating cerebral vascular obstruction. Cardiac infarction and cerebral apoplexy and angina pectoris. Reported by Mr. Uebara Kioshi of Kinki University

Taking Ganoderma can reduce the serious symptoms of the above diseases, without traditional treatment. Among these cases, was a patient with a right cerebral arterial obstruction which occurred twice. He received the best result after taking Ganoderma and Urokinase, together. Complete mobility finally returned.

A patient suffering from cerebral vascular obstruction, which was partially paralyzed, could move freely after taking Ganoderma. His free fat and Blipo protein value returned to normal.

Taking Ganoderma can also improve the condition of cardiac patients. This proves that taking Ganoderma together with other drugs, may result in better results. By the way, since diseases are difficult to cure, it is better to take Ganoderma regularly to prevent their occurring in the first place.

- 4. It is effective in the treatment of acute or chronic hepatitis, or liver dysfunction.
- 5. Reported by Dr.Mitsui Hashimoto of Hospital

At the present time, hepatitis is still a disease which can not be treated with any specific method If Ganoderma is effective, it would be a meaningful medicine for its treatment.

Six capsules per day were prescribed to some patients with hepatitis. Three months later, all patients were recovering, their GOT and GPT values decreased from 2000-3000 to 100.

In a addition, one patient who used Ganoderma together with some Chinese herbal medicines resulted in a decreased GoT and GPT. There was one case of hepatitis combined with hypertension. After taking Ganoderma, satisfactory results were obtained.The above conditions can be conclusive, but positive results of taking Ganoderma on hypertitis can be expected.

When liver function is declining, the patient may get tired. Taking Ganoderma can help ease fatigue.

- 5. The belief that Liver diseases are incurable should be abandoned.

The liver is the most important organ for health. Liver function is quite complicated. Therefore, Liver disease is considered difficult to treat, and dietetic treatment is the only method adopted by western physicians.

However, Ganoderma is able to make the complicated organ function, and have it return to normal. Based on our practical investigation. Ganoderma can contribute a very positive effect. Dr. Shigeru Yuji reported that 10% of liver disorders could be cured after taking for two months. 40% of the patients were relieved of their symptoms, and their liver size was reduced. 50% of the patients felt their symptoms diminish.

6.1 Pain from gastritis, gastric ulcer, duodenal ulcer, e.t.c, can be relieved immediately.

Reported by Dr. Taro Tamura of Kinki University.

We used Ganoderma in gastritis, gastric ulcer, and when he was young and which had recently returned.

Other medicines were effective, but one week after beginning treatment with Ganoderma his pain was significantly reduced. When the dosage was reduced he felt pain once a day or almost no pain at all. He usually used an analgesic, but it seemed useless. This treatment is also effective for gastritis and duodenal

ulcer patients who suffer from chest pain, loss of appetite, and gastric ulcer patients who are fatigue and feeble. It can also help gastric cancer postoperative pain. Some patients color improved and they put on weigh. Little after taking ganoderma.

6.2 Ganoderma protects the patients who overeat, or eat only one kind of food, or who are poisoned by food. It has surprising results in treating dysentery, constipation. gastric hyperacidity. And peptic ulcer. Its effects are equal to that of medicines now in common use. Dr.shigeru Yuji also reported its high efficacy in treating gastritis and ulcers.

The main functions of the stomach and intestines is stop absorbs the required nutrients in food, than excrete the wastes before fermentation. People usually eat too much, or eat and imbalanced diet, or it toxic foods, then their digestive organs are damaged. Ganoderma not only protect the organs but also improve the functioning of the digestive tract.

6.3. No need for the obese to go on starvation diets.

After World War ii. People were poor and did not have enough food to eat. It was needless to care about obesity. For more people were very lean. Due to medical progress and improved economic conditions, contagious diseases and poverty are much less of a problem, while chronic diseases and different kinds of adult diseases are increasing.

It was found in our investigation that thin people who take Ganoderma can Gain weight, and overweight people can lose weight No matter how old or young whether male or female, whatever ones constitution, Ganoderma can allow a person to maintain the optimal body weight and figure. Ganoderma will adjust the constitution and equalize biological functions if one takes it steadily..

8. Ganoderma is also effectively in treating varicose veins on the waist and shoulders, and rheumatism of the hand and knees. It can also treat sciatica.

Reprted by Dr. Taro Kiyobara of the Hospital of plastic and reconstructive surgery.

Ganoderma can be used to treat low back pain, and pain of the hands, shoulders and knees. There is no one case of varicose veins which improved a little.

Ganoderma is considerably effective in the treatment of pain caused by blood, blood vessels or hematoma on the torso. As to shoulder, neck and knee pain. In one case the pain originated from a deformed knee, but the pain was relieved.

Treating pain which results from some structural factor, such as low back pain caused by herniated intervertebratal disk is ineffective.

9.1 Ganoderma is a also effective in treating gynecological problems, such as menstrual cramps, vertigo menopause disturbances, etc.

Reported by Dr.Yoshinori Imanish Gynecology and Obstetrics Hospital.

The writer, who is an **OB-GYN** specialist, prescribed Ganoderma to women patients who had menstrual cramps, dizziness irregular menstruation, menopause disturbances. And difficulty in becoming pregnant.

There were three cases which had positive results. 40year old woman took Ganoderma for one month when her dizziness and shoulder pain were relieved. A pregnant woman had tightness in her chest in her chest and no appetite. After treating with Ganoderma her conditions improved. One woman with a physical disorder was married for many years. But could not conceive. After taking Ganoderma for three months she became pregnant. There are two cases where positive results were obtained from combining Ganoderma and herbal medicines,. In the first case, serious, serious dizziness and shoulder pain were relieved in three months.

In the second case, abdominal pain was reduced.

Ganoderma can relieve postpartum symptoms, acting as a hemocatharsis, diuretic, and detoxicant.

2. Ganoderma is a required medicine for pregnant woman and parturient woan.

When a daughter becomes pregnant. parents may wonder if it is safe to give her Ganoderma. The expectant mother may become moody, especially if it first pregnancy. During pregnancy, women are quite sensitive to outer stimulation, both mentally and physically. Though it is a natural phoenomena, most women have difficulty adapting.

During this period, taking ganoderma may act as a hem catharsis, a diuretic and a detoxicant and will allow the fetus to develop normally. It is said that Ganoderma may help the woman who is uneasy to get pregnant, or who has had habitual abortion before. Prof Kanata of Tohoku University believes that taking Ganoderma

can strengthen sexual ability of both the male and female, intensifying the activity of spermatozoa and regulating ovulation of the female,

Information from different sources reveals that Ganoderma may be thought of as the friend of the female, It should be considered a required medicine for women.

10. Ganoderma may affect a 100% cure for renal diseases.

Kidney disease is also one of the difficult diseases to cure. They include acute or chronic nephritis, diabetic renal syndrome, nephrosis and rheumatic fever. These may be due in part to a high cholesterol count and a high blood sugar level. The kidneys are overloaded and blood can not reach renal capillaries.

Nephritis results, with edema, urine retention, fatigue and possibly serious Uremia since Ganoderma can eliminate obesity, overweight people do not need to worry about their obese figures and the figure-conscious women do not need to suffer the pain and ill effects of starvation diets and weight loss drugs.

7.1 Taking Ganoderma together with chemotherapy may have significant results for patients who have had surgery for breast cancer, colon cancer or gastric cancer.

Reported by Dr. Hiroshi Kawi of Kinki University.

The experimental subjects were patients who were treated improperly after surgery, and patients who were suffering from the side effect of chemotherapy.

After a mastectomy, and chemotherapy, one patient's face became very dark. After using Ganoderma for two months, the numbness significantly improved.

Some patients use Ganoderma together with some herbal medicines for ten days after a colostomy, Night sweats disappeared and appetite improved.

In view of the above results, we can see that Ganoderma taken with chemotherapy can not be only a valuable auxiliary treatment, but side effect of the chemotherapy can be reduced

2. Prevents cancer metastasis, relieves pain, and can improve the chances for longevity.

Ganoderma belongs to the polyporaceae of fungi family, and is believed to be an effective cancer treatment in Japan, China, the USA, Canada, the U.S.S.R and Scotland. Some medical specialists in different countries are using the LATEST scientific instruments to do clinical tests, e.g., Prof. Ta-cheng, Medical College of the National Taiwan University. Prof. Cheng Hui-Hua and Prof. Ta-Cheng, Medical College. The experimental results have proved that Ganoderma is effective in cancer treatment.

Information concerning Ganoderma in treating cancer collected from Research reports are listed below:

1. The ant-cancer components of Ganoderma are polysaccharides and germanium.
2. Its efficacy is of additional efficacy and multi duplicative efficacy. Taken separately, no effects can be obtained.
3. It can strengthen stamina, elevate the immune system, and restrain cancer metastasis.
4. After undergoing surgery, It is helpful to patients with cancers such as esophageal cancer, Gastric cancer, breast cancer, intestinal cancer, fat accumulation and uterine cancer.
5. It can eliminate cancerous cells, increase appetite and relieve the pain of the late stage cancer.
6. It can be used together with other cancer treatment, such as surgery, radiation or combined with chemotherapy. It has no side effects and is effective.

Based on the above clinical reports, we may see that it possesses cancer preventing, suppressing and curing qualities.

Most of us may have dental caries, myopia or cancer tendencies when we are young, or they may develop at any time. We should try our best to prevent them from occurring. If we want to prevent tooth decay, we should eat more calcium and avoid sweets, If we want to avoid myopia, we should eat more vitamin A and avoid eye fatigue. If we want to prevent cancer, we should eat Ganoderma and avoid an imbalanced diet.

Prof. Fumio Tsurudani of the Nagoya University Medical Institute, Japan did an experiment with patients suffering from renal disease to check the effectiveness of Ganoderma. It was found that it did not only lower proteinuria and cholesterolemia, but could maintain renal proper function.

Based on our experimental results, renal disease can be cured 100% by taking Ganoderma. It is indeed of surprising achievement. Diabetes is no more a terrible disease.

It is sad that once you have diabetes, your life will be tangled with it. However, we cured a number of cases with Ganoderma.

As we know Insufficient insulin secretion is the cause of diabetes, and this results in some serious complications. Currently, western physicians use insulin injections as the only treatment. Though insulin is able to lower blood sugar level, the symptoms recur very soon. Furthermore, It is just like a cortisone hormone injection, with many side effects. Insulin is unable to recover pancreas function, and it speeds up the aging of the organ.

The medical research Institute of Kinki University found in yearly experiments that Ganoderma has the same function as insulin. Accordingly, after taking Ganoderma, not only can insulin deficiency be supplemented, but it can make the pancreas regain its original function. In addition, it does not have any side effects like Injection do.

The occurrence of hereditary disease can be prevented.

Many kinds of hereditary diseases have a high occurrence rate. If you are healthy at this moment, you want to maintain this condition all your life. Ganoderma can help you to this goal. Ganoderma's outstanding feature is that It can adequately reflect slight symptoms of diseases, keeping the human body in harmonious contrition. This expression is the conclusion obtained from experiments on thousands of people.

Ganoderma is a kind of medicinal food with over two thousands years of human experience. After long term experiments, its pharmacological nature has been further clarified, and it is widely used to maintain the health of human beings. Its position in the medical field has been firmly established.

Time passes too quickly. Won't you regret if you leave this world without taking it?

13. Ganoderma is also effective in the treatment of difficult and mysterious diseases. Such as:

1. No cause can be found
2. Even if the cause can be found, it is untreatable with drugs. For example blood pressure disorders are caused by many factors, but it is too complicated to understand the source and eliminate it. Even though antihypertensive drugs- relieve the symptoms; the source can not be eliminated.

For disease which can not be treated adequately with medicine, can not be diagnosed, or can not be cured by western drugs, Ganoderma considered a precious panacea. Only Ganoderma can treat these diseases successfully, eliminating the root cause of various puzzling diseases.

Appendix 1: Ten Major Causes of Death

1. Malignant tumor
2. Cerebrovascular disease
3. Accident
4. Cardiac disease
5. Hypertension
6. Chronic hepatitis and liver cirrhosis
7. Bronchitis
8. Diabetes
9. Tuberculosis
10. Suicide

Appendix 2: Reports from Japan

Physicians all over the world are concerned about high quality medicines. A new medical term Adaptogen has been coined to indicate the specific effects of Ganoderma.

After long term research and experiments done by large Japanese hospitals and research institutes. Ganoderma's positive effects have been confirmed in every respect; especially its hem catharsis effect i.e. improves blood circulation and cell quality. It allows the internal organs to function properly improves a weak constitution, and enhance the immune system. It has an evident efficacy in treating diseases caused by poor circulation. It is helpful in maintaining health... and for a healthy appearance. The Japanese medicine medical field is surprised and has acknowledged its positive effects on the following diseases:

1. hypertension and hypotension

2. Cardiac disease originating from hypertension and hematoma.
3. Cerebral apoplexy, high blood sugar blood vessel obstruction.
4. menopause disturbances gynaecological diseases
5. Constipation, hemorrhoids.
6. chronic hepatitis
7. Urination difficulties, frequent urination.
8. gastric diseases , duodenal ulcers
9. hypertensivity. Including nasal sensitivity and chronic catarrh.
10. Chronic bronchitis, asthma.
11. arthritis, lumbago, rheumatism (after middle age)
12. Insomnia, lethargy. Neurasthenia
13. Skin rashes due to hypersensitivity, athlete's foot and ringworm due to hematoma.

It may sound strange that Ganoderma has a universe effect, i.e. it can both raise and lower blood pressure. Actually, because Ganoderma can harmonize body functions, increasing the natural healing ability of the body, it can strengthen the immune system. Especially for the middle aged.

With Ganoderma. Some people may experience reactions after beginning treatment. Some may have dizziness, weakness, or itching or repeated defecation and urination. These are normal phenomenon, and indicate the positive effects are beginning. By dissolving the stored toxicants and discharging them patients with diabetes may lose a large amount of sugar, patients with rheumatism may have temporary intense pain. These phenomenons are purely the normal, functional, adjustments, within the body. It nothing but the performance of its efficacy. According to ones personal constitutional the reactions will disappear in a few days.

Since Ganoderma is a natural medicine, It can be used with other western drugs. Not only are there no adverse effects, it can also reduce the side effects of western drugs.

REISHI AS AN ADAPTOGEN

Patients Troubled by side effects from taking drugs like antibiotics, hormonal supplements e,tc often acquired other related illness. This problem is under serious debated by the medical profession since 1965. Recently the Royal Medical society of Russia. Australia and England developed a new medical concept of ADAPTOGEN, a substance hat is:

Non-toxic (no harmful side effects)

Not limited to special organs or tissues and.

Has over all normalizing effect.

With the above characteristics, the substance is termed as an adaptogen. Modern medicine based their diagnosis on examinations of organs and symptoms medications with known side -effects continued to be employed as long as they serve satisfactorily for their purposes. The adaptogen concept aims to cur by normalizing all body functions. It holds the notion that unless everything is put into its right track. There can be no complete cure; this idea coincides with the original supposition of superb herbs like REISHI and ginseng that normalize the body functions and with no side-effects. Its can be used as a preventive medicine. Because of this some people may develop a concept that RESHI can cure all types of disease. However be aware tat no substance can be an absolute, ultimate cure all.

MEDICAL COMPONENTS OF REISHI.

As previously reported, REISHI is recognized to be effective against a wide variety of diseases due to its extensive properties. Regrettably up to now there is no categorizing linking individual curative effect to its responsible components.

What has been found, however is that RESHI contains b-3 glucan polysacchaharide which is a potent ant canceremia agent. In 1984, Dr, komoto of Tokyo medical & dental university Japan, isolated the substance GANODELAN A and B FROM E extracts of REISHI glucan polysaccharides. At the same time he was also studying the body shape of RESHI in which I have participated. With further research results, it was found that GANODELAN composed mainly of lactosem glucose and glucuronic acid. Its molecular weigh is of 31000 and belonging to the molecular weight class 3600 of polysaccharide.

Experiments done on white mice found Ganoderma A & B to be responsible for lowering blood sugar content. When it is injected into test subjects abdominal cavity (concentration of 30mg/kg) analysis of samples 7 hours later found blood sugar level to drop 59% - 86%.

Long term use has significant effect on diabetes-one of the many uses of REISHI. However, Further research to pinpoint whether the effect comes from a combination of substances and how LANTAN. Another substance discovered in REISHI has been known to impede allergies

ADAPTOGEN

RESEARCH TEST OF REISHI IS PROVED

Long-term treatment of cancer with REISHI has success.

One such physician is Fukumi Morishige, M.D. Dr. Med. Sci. Ph.D. a former heart surgeon and now cancer surgeon who for over 30 years has routinely administered mega-doses of vitamin C to his patients originally to facilitate better healing of other wounds following surgery. After a visit to his hospital by Dr. Linus Pauling in 1975, at Morishige's invitation, his interests eventually turned to the use of the vitamin in the treatment of cancer. A report on this study and treating of cancer patients given bone marrow transplants.

REISHI is officially listed as a substance for treating cancer by the Japanese Government

The immune modulating effect doesn't seem to be only at the endocrine even as I continued; there is plenty of evidence for its effective use on cancer. In fact I have heard it is an officially listed substance to be used on cancer, recognized by the Japanese government in light of recent information. As I say I have no specific reference for this but its special area of use is to stop overcome side-effects of western chemotherapy and radiation therapy.

Now that worth reviewing right away. The Japanese labs are some of the best in the world,

REISHI augments immunoglobulin G and expands the memory of T-cells

Experiments at Drug Research Institute in Toyama, Japan confirmed that polysaccharides are responsible for the immune enhancement and it appears the crude extract of the ancient Ling Zhi (Ganoderma lucidum) augments the responsiveness of antibodies particularly immunoglobulin G (IgG) by expanding the so-called memory of T cells. Most likely involving helper T-cell

REISHI wakes up the Immune system early to fight cancer, helping to prevent it.

Vitamin C appears to increase the absorbability of REISHI polysaccharides, improving treatment of cancer and other types of diseases.

REISHI reduces blood fat levels, including bad cholesterol.

In up to 48% of heart disease patients, REISHI caused a marked improvement and in up to 86% a general improvement. This included patients with elevated blood lipids.

Mycelium of REISHI also found to be very effective.

Significant reduction in blood pressure was noted in humans after taking REISHI tablets for 10 days.

REISHI provided relief to 60-90% of chronic bronchitis sufferers. Older patients experienced greater relief.

REISHI IS AN AID IN OTHER IMMUNE- RELATED SENSITIVITIES SUCH AS CHRONIC PNEUMONIA, RHEUMATISM, HEPATIC DISEASE AND CANCER Dr. Morishige was among the first clinical witnesses to the antibody modulating effects of REISHI. He ran tests on the immunoglobulin levels of patients suffering from chronic bronchial pneumonia, rheumatic - autoimmune diseases, hepatic disease and cancer. He found that most of the immunoglobulin cases, those with too high a number of antibodies had reductions and those patients with too short a supply had their antibody levels increased.

REISHI use in the treatment of insomnia, gastric ulcers, liver disorders chronic hepatitis, neurasthenia, nephritis asthma, bronchitis, hypertension and poisoning is part of its traditional oriental application. Its use in reacting diabetes is much less recognized and at the outset one would tend to think REISHI was not appreciated for this affliction. A clinical study in China with heart disease and chronic bronchitis patients found blood glucose markedly increased.

Alcohol extract of REISHI aids against liver necrosis and hepatitis.

REISHI lowers triglycerides in 68-74% of patients at risk for heart disease,

REISHI helps to regenerate the liver.

Insomnia relieved by REISHI.

Calming effects on the nervous system are noted after consumption of REISHI.
 Stress- Induced tension, myasthenia gravis and muscular dystrophy have all been treated with varying degrees of success.

Results Of Analysis On Oyster Mushrooms

KENYA INDUSTRIAL RESEARCH AND DEVELOPMENT INSTITUTE

P.O Box 30650 NAIROBI

Tel; 535966/84/90

Direct line: 555011

Junction of Dunga and Lusaka Roads- Industrial Area

LABORATORY REPORT

Material **DRIED OYSTER MUSHROOMS**

Laboratory no.....14/05/06.....

Date received-3/08/2005-Sampled by VIMPRO

Received from.....G.T.Z.(PSDA).....

Lab. No.	140/05/06
Sender's Ref:	-
<i>Parameters:</i>	
Proteins (% _{w/w})	33.28
Iron (% _{w/w})	0.02
Zinc (% _{w/w})	0.008
Fibre (% _{w/w})	7.60
Vitamin C (Ascorbic acid) (% _{w/w})	0.07
Selenium (% _{w/w})	N.D
Carbohydrates (% _{w/w})	36.80
Fat (% _{w/w})	2.26
Free fatty acids (as Oleic acid) (% _{w/w})	0.96
Phosphorous (% _{w/w})	0.43
Magnesium (% _{w/w})	0.21
Calcium (% _{w/w})	0.006
Sodium (% _{w/w})	0.06
Potassium (% _{w/w})	2.15
Moisture (% _{w/w})	13.51

Ganoderma mushrooms have got the following medicinal properties:

1. Lowers cholesterol in the blood and the amount of free fat
2. Reduces blood sugar level; to restore pancreas functions
3. Lowers blood lipids and stabilizes red cell membrane.
4. Due to Ganoderma contains Adenosine it can lower platelets angulations, and leys thrombi and prevent thrombogenesis
5. Improves the function of the Cortes of the adrenal glands to maintain endocrine balance.
6. Elevates the natural healing ability of the body, allow the body to established a strong immune system.
7. Prevent tissue cell degeneration.
8. Prevents senility. Maintaining a youthful constitution.
9. Lowers the side effects of antihypertensive drugs.
10. Prevent organ degeneration.
11. Prevents allergy caused by antigens, because it inhibits the amine releasing mast cell.
12. Prevents and treats cancer and inhibits cancer cell metastasis.

- a. Normalizes to prevent tissue degeneration
- b. Prevents sudden death of cancer patients caused by embolism.
- c. Inhibits thrombogenesis and lyses thrombi on the wall of surrounding tissue and removes blockade of cancer medication, Increases these drugs effectiveness.
- d. Relieves pain caused by cancer.

Mushroom Growers Terminologies

1. Substrate

Compost in which to grow the mushrooms i.e sugarcane bagasse and leaves, banana fibre and leaves, cotton waste etc.

2. Mycelium

Vegetative part of fungi. These are thin spider web-like growths that bear spores and grow through carrier materials or substrate.

3. Spawn (mushroom seed)

These are mycelium growing through carrier materials or substrate normally wheat or sorghum grains

4. Inoculation

Introduction of mycelium to carrier or spawn to substrate under extreme hygienic conditions.

5. Spawn Run

Describing initial appearance of mycelium in substrate.

6. Primordium or Pin heads

The first visible mushrooms in the beginning of growth.

7. Cluster

Several mushrooms growing together from one point or from one stem.

8. Fruiting

Mushrooms are said to be fruiting when the pin heads start to appear.

9. Fruit body

This is the actual mushroom

10. Run through (Colonization)

In this the substrate is grown with mycelium.

11. Contamination

The presence of unwanted organisms like green, black and pink moulds, bacteria/viruses and weed (competitor) mushrooms in the substrate.

12. Culture

Nutrient materials used for mycelium growth in laboratory. They include growth in organic soils, plant growth regulators, Vitamins, amino acids and complex organic supplements, carbohydrates, water and

media matrix. About 7.2-7.5. Bring the moisture content to 70%. Pasteurize the casing mixture at a temperature of 60-70°C for two hours. The casing layer should be about 2 cm thick.

Requirements for Mycelium Growth and Fruit Body Formation for Oyster Mushroom

- Temperatures of 15-32°C
- Ph of ABOUT 6.5
- Carbon dioxide (CO₂) level to be between 15-20%
- Humidity to be between 86-90%
- Reduce CO₂ to between 0-0.6 percent
- Regulate the temperatures to 10-28°C and humidity levels of 86%. If the mushroom develop long stalks and short cap your lighting and ventilation will have been inadequate.

Inputs for Mushroom

- Polythene bags (black or white)
- Lockable metal Drum
- Polythene tubes
- Methylated spirit or jik
- Table or polythene sheet (3 metres)
- Table spoon
- Fuel
- Water
- Labour
- Spawn (seed)
- Weighing scale
- Lime
- Supplement (Soybean meal or keratin)
- Molasses
- Substrate
- Sisal twine
- Soap
- Shed
- Basin
- Hand gloves
- Dust coat
- Cap
- Dust masks
- Hand spray pump

(1) Mushroom house

Mushroom house should not be sited near dumping sites and livestock pens to reduce the risk of insect infestation and diseases. It should preferably be under shade. The house can be made from locally available materials that can main cool temperatures and high humidity such as clay or bricks. In a small scale farmer scenario, a grass thatched mud walled house is the most ideal. The house should have air vents or small windows on the upper walls for ventilation and required light during fruiting. The vents and door should

have insect screens and be closed. If the temperature inside the house is high, water can be sprayed on the floor using a knapsack sprayer with fine nozzles and vents and door opened at night. Wooden shelves for holding bags or wooden racks for hanging spawned substrate tubes should be constructed at the height of about 1.5 m from the ground and 1 m apart for ease of working in the growing house.

(2) source(s) of high quality spawn ('seeds' of mushrooms)

Spawn in a bottle Spawn is a planting material equivalent of farmers' seed for starting mushroom cultures. It is made from mycelia (plural of mycelium) of mushroom grown on a carrier such as grains and is produced in specialized laboratories under sterile conditions. The amount of spawn needed is equal to 4-6% of the wet weight of the substrate. For example if the wet weight of the substrate is 50 kg, 2-3 kg of spawn is required. One kg of spawn may cost between Kenya shillings 600 and 800.

(3) Substrate (material on which mushrooms grow)

Substrate is an organic-based material on which mushrooms grow. And a good substrate should be rich in nutrients, have good aeration and water holding capacity. Substrates commonly used in mushroom production include agricultural by-products such as cereal straws (wheat, barley, rice, maize), cotton waste, maize cobs, coffee husks and pulp, sawdust, sugar bagasse, water hyacinth among others. Growing mushrooms on a substrate of water hyacinth was first promoted by the Chinese University of Hong Kong, and has been taken up by the African University of Mutare in Zimbabwe. The advantage of using water hyacinth, which is an unwanted weed that clogs up many waterways in Africa, is that the costs of preparing the substrate can be kept down. However, cereal straws, particularly wheat straw, are usually the best because they are rich in nutrients that mushrooms require and they facilitate quick colonization (the formation of a white mass of mushroom mycelium) of the substrate.

Gypsum is a useful ingredient to be added to the substrate as it provides calcium to the growing mushrooms, regulates the acidity level of the substrate, counters potassium, magnesium and phosphorus concentration and increases water holding capacity thus decreasing the risk of over wetting. It also improves the physical structure of the substrate. Lime may also be added to the substrate to adjust its pH (level of acidity)

It should be noted that different species of mushrooms will require different substrate mixes. The substrate must not be rotten, mouldy and should be kept dry while in storage.

Types of Mushrooms and Substrates used for their production

Mushroom Cultivation Media	
Growing Medium	Mushroom Species
Rice straw	Straw (Volvariella) Oyster (Pleurotus) Common (Agaricus)
Wheat Straw	Oyster (Pleurotus) Common (Agaricus) Stropharia Straw (Volvariella)
Coffee pulp	Oyster (Pleurotus) Shiitake (Lentinus)
Sawdust	Shiitake (Lentinus) Oyster (Pleurotus) Lion's Head or Pom Pom (Hericium) Ear (Auricularis) Ganoderma (Reishi) Maitake (Grifolia frondosa) Winter (Flammulina)
Sawdust-straw	Oyster (Pleurotus) Stropharia

Cotton waste from textile industry	Oyster (Pleurotus) Straw (Volvariella)
Cotton seed hulls	Oyster (Pleurotus) Shiitake (Lentinus)
Logs	Nameko (Pholiota) Shiitake (Lentinus) White jelly (Tremella)
Sawdust-rice bran	Nameko (Pholiota) Ear (Auricularis) Shaggy Mane (Coprinus) Winter (Flammulina) Shiitake (Lentinus)
Corncoobs	Oyster (Pleurotus) Lion's Head or Pom Pom (Hericium) Shiitake (Lentinus)
Paper	Oyster (Pleurotus) Stropharia
Horse manure (fresh or composted)	Common (Agaricus)
Crushed bagasse and molasses wastes from sugar industry	Oyster (Pleurotus)
Water hyacinth Water lily	Oyster (Pleurotus } Straw (Volvariella)
Oil palm pericarp waste	Straw (Volvariella)
Bean straw	Oyster (Pleurotus)
Cotton straw	Oyster (Pleurotus)
Cocoa shell waste	Oyster (Pleurotus)
Coir	Oyster (Pleurotus)
Banana leaves	Straw (Volvariella)
Distillers grain waste	Lion's Head or Pom Pom (Hericium)

(4) Supplements (additional nutrients to the substrate)

Supplements are materials added on the final mix of substrates to increase nitrogen content in order to improve the yields. Commonly used supplements include urea, bran, cotton seed cake, sunflower seed cake, molasses, broiler chicken manure and horse manure among others. However, it should be noted that heavy supplementation may increase the risk of contamination by other micro-organisms which are likely to benefit from extra nutrients added to the substrate.

Production of Mushroom

Modern structure for mushroom production



The front view of a modern mushroom production shed.

Substrate sterilization

1. Weigh the substrate when still dry; spread it on a table or polythene sheet which is spread on the floor. Take the following and add to the substrate in the following ratios: 1% of lime or gypsum of the dry weight of the substrate for control of Ph, aeration and acceleration of colonization of the substrate , 5% supplement – cotton seed cake or sunflower seed cake or soy bean meal cake of dry substrate to improve the protein and mineral nutrients to the substrate 5% of molasses to improve the nutritional value of the substrate in terms of carbohydrates. Put water in a basin and mix all the above thoroughly to form a solution. Sprinkle the solution on the substrate and mix it thoroughly. Add in more clean water till the whole substrate is wet. Apply the squeeze test. Only a few water drops should come out of substrate, and then know it's ready for use. Stack the substrate in empty polythene -bags (preferably 12'' x 18'' of gauge 125 – 150 either black or clear and close the top tightly using a string - sisal twine.
2. Put a wooden rack with a height of around twenty 6 inches at the bottom of a drum,
3. Fill water in the drum up to the height of the rack,
4. Pack the filled bags inside the drum placing them on the rack. Avoid the tubes from touching the water for we need the substrate to sterilize by use of steam
5. Close the drum using a lockable lid and punch a small hole at the top to allow the excess steam to escape via it. Boil the substrate until you start seeing steam coming out of hole. Start counting 45-60 minutes from the time you see the steam. Reduce the amount of heat being supplied to the drum for 15minutes. Let it cool before you remove the sterilized materials. Caution – Let the drum cool down completely before you open the lid to avoid being burned by the steam.
6. Remove them from the drum and let them cool down overnight. They should be stored in sterile environment to avoid contamination.



The substrate is being mixed with broiler starter, water, molasses and lime



The substrate being bagged for sterilization

Spawning

Select your working area which should not have dark alleys that are good breeding grounds for bacteria and fungi. The area should have controlled air/current flow.

Take the substrate, spread it on a sterilized table or polythene sheet by use of methylated spirit or surgical spirit or jik and inoculate it with the spawn. Spawn application should be 2 kgs of spawn to 15 kg of dry weight of substrate. There after, the inoculated substrate is then compacted in the polythene tube and close the top by use of a sisal string.

Perforate holes round the tube. The holes should be 2 inches in diameter with a distance of 4 inches from one another. Make sure there are no air pockets in the poly bag. After 14 days, increase the humidity in the house by pouring clean water on the flour for it to start vaporizing to humidify the room. Do not spray water in the room for it will contaminate it. This can be done 3-4 times per week depending on the temperatures.

After 6-7 days the pin-heads will start to appear, reduce the humidity. Within 2 -4 days' mushrooms will be ready for harvesting. Ensure to harvest before they are fully grown. Continue pouring water on the flour

and the cycle will repeat itself 4-5 times flushes. This will also depend on the amount of nutrients in the substrate.



The stalked substrate bags are placed in the drum which is heated for a period of 45 minutes.



The substrate after spawning and stalked in tubes ready for hanging in the shed



Tubes having been hanged in the shed to start colonization



The tubes have fully colonized and mushrooms are about to sprout. The system is now favoured by all mushrooms farmers for it has reduced the cost of labour in terms of spraying water and generally on crop management. Production is nearly 100%.



A farmer admiring his mushrooms in his shed ready for harvesting.



Mrs Khabega a mushroom farmer in Nakuru town admiring her good Quality mushrooms after harvesting ready for the market.



Mrs Khabega's fresh oyster mushrooms packaged ready for market delivery

Trouble Shooting

“Prevention is better than solving the problem”

PROBLEM	CAUSE	SOLUTION
Mycelium fails to form	Improper initiation strategy.	Check substrate, timing of spawn, inoculation, moisture;
	Chlorinated or contaminated water	Use activated charcoal water filters to eliminate chemical contaminants or any other ways of simple or appropriate technology.
	Bad substrate.	Eliminate the substrate. Start with a fresh substrate.
	Bad pasteurization	Check method of pasteurization. Release all air and make sure there is continuous steam before starting pasteurization for a period of 1 hour.
	Substrate in the bag is too hot when inoculation	Make sure that the substrate bag is not too hot before inoculation.
	Bad strain or spawn	Obtain younger strain of known vitality & history.
	Spawn contaminated	Pasteurize and inoculate again with good spawn.
	Forgot to inoculate the bag.	Make sure to inoculate.
Poor spread of mycelium, bad smell, spots and mites.	Good pasteurize but must decrease the temperature in the pasteurization chamber. Pasteurization was too quick and/or the chamber door was opened too quickly.	Slowly decrease the temperatures in the chamber. Do not open the cover of the chamber too quickly. Check that the cotton plug is tightly closed.
	Inoculation process	Inoculate in hygiene conditions; clean and with no air movement.
	Too high density in the incubation area, not enough ventilation to decrease.	Spread the bag and make more air ventilation in the incubation area. Check temperature and control surroundings to.
	Accumulated temperature.	Maintain 25-35 degrees Celsius.

	Too high carbon dioxide	Not more than 5% carbon dioxide. Check ventilation.
	Hygiene of incubation house	Improve hygiene in the incubation house.
	Mycelium develops in patches. Substrate is not evenly prepared and some parts have more nutrient than others	Mix well in substrate.
	Bacteria, other fungi contamination.	Check the process causing contamination. Separate contaminated bags as soon as possible. Remix substrate separately. Remake substrate bags and pasteurize for a longer time. Follow process.
	Mite contamination.	Immediately separate contaminated bags and pasteurize again. Continue the normal process.
Mycelium grows but fails to produce mushrooms.	Substrate formula is not suitable	Adjust formula; check PH; sawdust ; additives etc.
	Mites, mould, virus, bacteria and insects.	Check pasteurization process, inoculation, other process, and mushroom house management for hygiene.
	Inhibited by environment toxins	Remove source of toxins.
	Bad strains or spawn	Acquire new strains.
Mushrooms form, but abort or delay mushrooming.	Primordia and growth condition of fruiting body are not good enough	Check temperature and humidity. Open or close doors and windows to adjust accordingly.
	There is contamination such as mould, bacteria, insects, worms and mites	Check hygiene, adjust environment of light. Temperature, humidity and ventilation. In more severe cases, use half a teaspoon of sulphur in 3.5 litres of water. Mist the bags and the surface of the mushrooms. Remove contaminated bags from mushroom house and recycle.
	Chemical contamination from	Remove toxins.

	solvents, gas, chlorine etc	
	Bad strain	Acquire a new strain or find a new supplier.
Mushrooms form, but stems are long and caps underdeveloped	Inadequate light	Increase or adjust light to correct wavelength.
	Excessive carbon dioxide	Increase air exchange, open doors or windows and close at correct time.
Massive numbers of mushrooms form, few develop.	Too long time incubation	Shorten the period for the formation of primordia
	Lack of oxygen, inadequate light	Increase air ventilation and open more windows or doors to receive more light.
	Inadequate substrate nutrition or low quality.	Reformulate or check raw materials.
	Low rate mycelium growth	Use the high rate spawn or adjust good conditions for rate of growth.
	Poor strain	Obtain better strain.
Mushrooms are deformed, decay and die	Disturbed by germs or competing micro organisms	Adjust mushroom house to favour mushrooms and not germs and competitors.
	Dirty surface of substrate bags	Clean the surface of substrate
	Not enough air ventilation, too high humidity.	Increase air circulation. Reduce humidity to the prescribed levels. Surface water must evaporate from mushrooms several times per day. Check watering. If there is water in bags. Pierce bags and drain water.
	Bad strain.	Acquire better strain.
	Use of chemicals during this period.	Never use chemicals during the fruiting stage

Mushrooms are flipped	Inadequate substrate nutrition	Reformulate
	Competitors	Check hygiene, adjust light , temperature, humidity air and ventilation
	From management growing house	Improve management
	Bad strain.	Acquire new strain.
Mushrooms small sized.	Too many mushrooms coming out at the same time.	Reduce size of opening(s).
	Lack of nutrients in substrate.	Review quality of substrate.
	Change of weather.	Be aware of wide range of changes in temperature.
	Spawn unhealthy.	Check origin of spawn.
Pests and insects	Natural occurrence, humid climate.	Place lemongrass plants around mushroom house. Spread lime on shelves, on poles and ground in the mushroom house. Clean (and maintain clean) the mushroom house properly.
	Mushroom waste lying around mushroom house.	Try to use the waste as fertilizer or recycle.
	Ants	Mix. Do not put with Mushroom. place on their
Mushrooms are light in weight	Shortage of water.	Check humidity of mushroom
Mushroom quickly spoil	Mushrooms too mature when harvested.	Harvest when younger.
	Mushrooms too warm before packaging	Chill mushrooms before placing in marketing containers.
	Mushrooms too wet when harvested.	Reduce humidity several hours before harvesting.

	Mushrooms stored beyond	Sell mushrooms faster.
Rotting sport on mushroom fruiting body because of bacteria during flush.	Bacteria (<i>Pseudomonas tolaasil</i> , <i>Pseudomonas fluorescens</i>) on oyster mushroom.	Control humidity in the mushroom house and maintain 80-85%. Give enough time for water to evaporate from mushroom surfaces before further watering. For sever cases, use 113 grams chlorine mixed in 45 litres of water or 4 ounces of chlorine per gallon of water.

TRUE FUNGAL DISEASES:

Dry bubble caused by *Verticillium fungicola*. It causes a severe loss of yield. It is characteristic of cinnamon brown spot on the mushroom fruit cap as the disease progresses the mushrooms become deformed with swollen, curved stipes and the cups develop asymmetrically. Ben late is the fungicide for control.

Mycogyne sp. This is a more recently introduced fungus with greyish mycelia, which grow and stifles the mushroom fruit. If it attacks before the fruits are formed then it causes failure in expansion of the pinheads. Control is by observation of hygienic measures. Affected trays should be removed out of the growing room and the material burnt.

Bacterial Diseases:

Bacterial Blotch, *Pseudomonas tolaasi*. It starts as yellow spots and gradually turns chocolate brown on the fruit. The mushroom cup feels slimy. The mushroom cup feels slimy. The whole cap may turn brown. For control, lower the humidity; do not leave water droplets on the cap. Use chlorinated water.

Virus:

Die back disease, results in the total loss of the crop. It displays a number of symptoms, patches of uncolonized casing. The mycelia die back. The cup and stripe have a drumstick. The stripes may be watery split and rotten. The cups open and flatten too early. Should this disease be noticed then the room must be steamed for twelve hours. Mushroom mycelia containing the virus should be removed and destroyed.

Mushroom competitors and diseases

TrichocieFma causing 30% fose

- Bacteria
- Competitor mushrooms
- Viruses
- Carbon dioxide accumulation
- Light deficiency and pesticide effect
- Trichoderma to be controlled by:-
- Pasteurisation of substrate
- Spore filters in inoculation rooms
- Use of other THcafs in substrate e.g. pfochorus, vmctozofin orbenomfyat 20-50mls for 5 litres of water.

Pest

These are sciarids and phorids which are attracted by mycelium scent,

Control

Use wire mesh in windows

- Yellow plastic for monitoring
- Sticky traps
- Pesticides e.g. Malathion, diltathric
- Dichlorus and diflubenzuron

Termites

Use oil on timber works, drenching line around the housing and even gladiator, given our Geographical tropical location on the equator a suitable Housing is once of mud walls and a grass thatched roof. The current research has shown that the use of iron sheets improves the humidity of the shed provided the temperatures do not go beyond 32 degrees Celsius.

The inside is entirely cushioned with a PVC lining to assist in retaining moisture/humidity for longer periods. Light is a stimulus for growth and therefore assists Primordial development.

Note

That during the period of incubation and growth, you will notice the following:

1. Materials in the tube developing moulds – green, pink or black. With the green mould you take hydrogen peroxide and inject it direct using a syringe with a needle to the affected areas without diluting it. If it persists discard the tubes. With the other moulds do not apply hydrogen peroxide but instead discard all the affected tubes by burring them dip in the soil.
2. The mushrooms will be turning yellow in colour and drying from the edges. This shows that there is no enough water in the tube. You therefore need to add at list 2 litres of sterilized water from the top of the tube by use of a used water plastic bottles.
3. Mushrooms will start reducing in size. This is as a result of low nutrients in the growing materials. You need to add to every tube 250 gms of molasses and 250 grammes of broiler starter or cakes of soya beans or sunflower or cotton which you have to mix with water and sterilize for 1 hour to avoid contamination. Use a 1 litre bottle to pour the solution into the tube from the top.

MUSHROOM PRODUCTION COSTING PER CENTRE FOR THE 1ST YEAR.

Capital Investment	1st production			2nd production			3rd production			4th production		
	Quantity	Unit price Kshs	Total Kshs	Quantity	Unit price	Total	Quantity	Unit price	Total	Quantity	Unit price	Total
hand spray can	1 pc	300	300	-	-	-	-	-	-	-	-	-
driers	2pcs	7,500	15,000	-	-	-	-	-	-	-	-	-
shed	1hs	61,000	61,000	-	-	-	-	-	-	-	-	-
weighing scale	1pc	2,500	2,500	-	-	-	-	-	-	-	-	-
drums with lid	2pcs	2,000	4,000	-	-	-	-	-	-	-	-	-
basin	1pc	100	100	-	-	-	-	-	-	-	-	-
table spoon	1pc	10	10	-	-	-	-	-	-	-	-	-
hand gloves	6pcs	100	600	-	-	-	-	-	-	-	-	-
Masks	6pcs	40	240	-	-	-	-	-	-	-	-	-
gum boots	3pcs	800	2,400	-	-	-	-	-	-	-	-	-
caps	3pcs	100	300	-	-	-	-	-	-	-	-	-
dust coats	6pcs	1,200	7,200	-	-	-	-	-	-	-	-	-
water jug	1pcs	50	50	-	-	-	-	-	-	-	-	-
water pails	5pcs	100	500	-	-	-	-	-	-	-	-	-
mixing table	1pcs	2,500	2,500	-	-	-	-	-	-	-	-	-
Sub total			96,700	-	-	-	-	-	-	-	-	-
Operational costs												
spawn	300kg	400	120,000	300kgs	400	120,000	300kg	400	120,000	300kgs	400	120,000

	s						s					
substrate	1lorries	10,000	10,000	1lorries	10,000	10,000	1lorries	10,000	10,000	1lorries	10,000	10,000
spirit	20litres	150	3,000	20litres	150	3,000	20litres	150	3,000	20litres	150	3,000
Broiler starter	2 bags	3,600	7,200	2 bags	3,600	7,200	2 bags	3,600	7,200	2 bags	3,600	7,200
molasses	2 Jeri cans	700	1,400	2Jericans	700	1,400	2 Jeri cans	700	1,400	2 Jeri cans	700	1,400
Polythene bags	3 pkts	500	1,500	3 pkts	500	1,500	3 pkts	500	1,500	3 pkts	500	1,500
polythene rolls	2rolls	3,500	7,000	2rolls	3,500	7,000	2rolls	3,500	7,000	2rolls	3,500	7,000
lime	1pkt	650	500	1pkt	650	500	1pkt	650	500	1pkt	650	500
water	1season	3,000	3,000	1season	3,000	3,000	1season	3,000	3,000	1season	3,000	3,000
sisal twine	2pcs	200	400	2pcs	200	400	2pcs	200	400	2pcs	200	400
fuel	1season	3,000	2,000	1season	3,000	2,000	1season	3,000	2,000	1season	3,000	2,000
Labour people	3 3months	3,000	27,000	3months	3,000	27,000	3months	3,000	27,000	3months	3,000	27,000
Sub-total	-	-	183,000	-	-	183,000	-	-	183,000	-	-	183,000
Post harvest cost	-	-	-	-	-	-	-	-	-	-	-	-
packaging materials	3,000kgs	5	15,000	3,000kgs	5	15,000	3,000kgs	5	15,000	3,000kgs	5	15,000
transport to mkt	3,000kgs	5	15,000	3,000kgs	5	15,000	3,000kgs	5	15,000	3,000kgs	5	15,000
Sub-total	-	-	30,000	-	-	30,000	-	-	30,000	-	-	30,000
Total	-	-	309,700	-	-	213,000	-	-	213,000	-	-	213,000
Add 2% misc. costs			6,194	-	-	4,260		-	-		-	-
Total project cost	-	-	-	-	-	217,260	-	-	217,260	-	-	217,260
Expected yield	-	-	3,000kgs	-	-	3,000kgs	-	-	3,000kgs	-	-	3,000kgs
Less 2 % spoilages	-	-	60kgs	-	-	60kgs	-	-	60kgs	-	-	60kgs
Saleable yield	-	-	2,940kgs	-	-	2,940kgs	-	-	2,940kgs	-	-	2,940kgs
Production cost / kg	-	-	107.50	-	-	73.90	-	-	73.90	-	-	73.90
Sales price /kg	-	-	200.00	-	-	200	-	-	200	-	-	200
Gross margin	-	-	92.50	-	-	126.10	-	-	126.10	-	-	126.10
Expected income	2,940kgs	200	588,000	2,940kgs	200	588,000	2,940kgs	200	588,000	-	-	588,000
Gross profit	-	-	270,300	-	-	370,740.00	-	-	370,740.00	-	-	370,740.00

Aggregation and Processing

Harvesting

Oyster about 30 days, button 30-40 days from spawning to harvesting.

Oyster harvesting is done when the mushroom ear is 7.5-10 cm in diameter, turgid and bright in colour. Button is picked at the young stage before opening. Repeated over 7-10 day cycles.

Aggregation

Fresh and dried mushrooms are collected from centers after farmers delivery and taken to a central place for sorting, grading packaging and delivery to the market. However, not all the delivered mushrooms are taken to the market but are used for value addition

Adding Value to Fresh Mushrooms

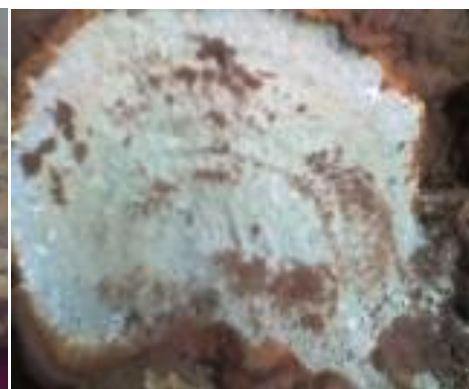
Adding value to fresh mushrooms usually means either developing a processed product, such as a sauce, or drying surplus mushrooms for sale in the off-season, when prices are higher. A value-added product can be sold either directly to the consumer or to wholesalers.



A simple model of a solar drier developed by farmers for the dehydration of mushrooms. This system of drying helps to maintain the quality of mushrooms in terms of colour, aroma and retention of the nutritional value and especially the vitamins. This also makes the mushrooms to have a longer shelf life.



Oyster Mushrooms



Ganoderma Mushrooms

Dried mushrooms of oyster and ganoderma. These are further ground into powder form.



Mushroom powder ready for market and for products development.



A Mushroom Products Shop.