

**NEWPORT INTERNATIONAL JOURNAL OF CURRENT RESEARCH IN
HUMANITIES AND SOCIAL SCIENCES (NIJCRHSS)**

Volume 3 Issue 2 2023

The Impact of Mushroom Characteristics on the Performance of Oyster Mushrooms among Small-Scale Farmers: A Study in Mumias Division, Mumias Sub-County, Kenya.

Andrew, O. Nyakundi

Faculty of Business and Management Kampala international University-Western Campus, Uganda

ABSTRACT

Mushroom cultivation plays a crucial role in bolstering a country's economic development, offering both nutritional and medicinal benefits. The global mushroom industry comprises edible, medicinal, and wild mushrooms, with global production being relatively low, especially in Africa due to factors such as ignorance, negligence, and marginalization. Of the 64,000 mushroom species worldwide, only 300 are edible, and merely 30 are cultivated. The accurate identification of edible varieties stands at a meager 17%, possibly contributing to concerns about poisoning incidents and hindering mushroom production. In Kenya, the domestication of two mushroom varieties, Button and Oyster, has resulted in an annual mean production of 500 tons, supplemented by importation of 150 tons. The characteristics of mushrooms, such as anatomy, smell, and color, play a crucial role in distinguishing between edible and inedible varieties, yet research on these aspects remains insufficient. This study aimed to explore the impact of mushroom characteristics on the performance of the oyster mushroom enterprise. Anchored on the Need for Achievement Theory and guided by a conceptual framework, the research employed a descriptive research design with a study population of 300, from which a sample of 30 growers participated. Cluster random sampling was utilized, and data were collected through questionnaires, analyzed using SPSS. The findings revealed a predominance of female (53.3%) over male (46.7%) participants in mushroom production, with older individuals (66.6%) outnumbering youths (33.3%). Most growers (76.7%) had less than one year of experience. The study highlighted that oyster mushrooms exhibit a grey color and a pleasant smell. In conclusion, mushroom characteristics significantly influence the performance of oyster mushrooms. Recommendations included the adoption of new mushroom species, the establishment of a Mushroom Training Institute, and the development of incentive schemes. The outcomes are expected to benefit policymakers, mushroom growers, scholars, and researchers, contributing to the advancement of mushroom cultivation practices.

Keywords: Mushroom characteristics, Production, Performance

INTRODUCTION

Mushrooms are very important products and are cultivated globally. The major components of the global industry include edible, medicinal and wild mushrooms [1]. Mushrooms belong to fungi kingdom and evolved from algae. They are heterotrophic, incapable of synthesizing their own organic materials [2]. Mushroom cultivation is considered as an enterprise because it is an economic activity leading to income generation and is non-agricultural farming not in need of vast land compared to conventional farming but can utilize vertical space which is indoor cultivation. Globally China takes the lead in production of edible mushroom accounting to more than 80% [3] of all Oyster (*Pleurotus spp*) grown globally. Production trend in Africa is low and demand is high. [4], opined that mushroom production in Africa is rarely mentioned or appears on publications. Therefore, it seems that mushroom as an enterprise has been ignored, neglected and marginalized. [5], observed that since production is low, it creates an opportunity in Africa to cultivate mushroom at subsistence and commercial levels. According to [6], mushroom has a high value with a lot of potential to significantly contributing to economic development of a country, an area which require attention. There are many species of mushroom worldwide which can be cultivated

to spur economic growth and alleviate both food insecurity and malnutrition facing mankind. However, the spread and expansion are constrained majorly by inadequate knowledge on mushroom characteristics. A survey conducted on mushroom species show that there are 64,000 known species and are documented [7]. Further, available publications show that 10,000 species are capable of producing mushrooms, about 300 are edible and small number of 30 species have been cultivated [3]. Africa could be the home of most of the mushroom species but many might have disappeared before science had an opportunity to describe them [7]. The mushroom may be edible or poisonous. Many people get problems when feeding on unidentified type of mushrooms. Therefore, identification of inedible or toxic mushroom is crucial which should be based on mushroom characteristics [2]. The varieties or species of mushrooms, each has distinct characteristics which could be pleasant or unpleasant to the customers or consumers. The generic characteristics for edible mushrooms include colours of pileus(cap), lamellae(gills) and stipe(stem) also the presence of annulus(ring) and volva. If these vital five characteristics are well known, they can help to differentiate edible from toxic mushrooms, the consumption can be exponential thus creating huge mushroom industry in Africa. In India, there is slow expansion of mushroom farming caused by mainly inadequate knowledge on mushroom characteristics, poor cultivation methods and depressed markets especially at glut phase [9]. There are myriad challenges facing farmers in Indonesia such as low yield, negative attitude towards mushroom enterprise, poor quality spawn and insufficient capital. In Kenya, variety or species of mushroom is a major constraint to accelerated growth of mushroom. [10], in their study reported only two mushroom varieties grown in small and large scale namely Button (*Agaricus bisporus*) and Oyster (*Pleurotus spp*). However, their potential is not fully exploited [11]. Addition challenges include lack of market, lack of capital, lack of cold rooms for preservations consequently leading to huge post-harvest losses. The production in 2017 was 484.5 metric tons and consumption demand were 1200 tons per year [10]. Production in Mumias division is also low due to the challenges cited by [11] although not exhaustive [11]. However, contamination at substrate preparation, spawning and in growing house is emerging as another threatening factor [12]. There was only one mushroom variety grown in this division, Oyster (*Pleurotus spp*). The low production and slow adoption rate were largely due to insufficient knowledge on how to identify edible mushroom variety and myth associated with poisoning effect. Therefore, knowledge of characteristics of edible is seldomly available to growers.

Problem statement

Mushroom enterprise can play a vital role in an economic development of a country and would make immense contribution towards achievement of global sustainable development goals by 2030 [13]. Particularly goal 2: on zero hunger. This goal aims at ending hunger through food security, improved nutrition and promoting sustainable agriculture. Empirical studies show that there is consistent gap between production and consumption demand in Kenya. The mean annual mushroom production is 500 metric tons while importation is 150 metrics [14]. In 2017 the gap widened when production was 484.5 metric tons and consumption demand was 1200 metric tons [10]. The poisoning incidents of mushroom could be affecting mushroom production. The mushroom characteristics help to distinguish between edible and inedible mushrooms and correct identification has been rated at 17% globally [15]. The issues of concern are oyster mushroom anatomy, smell and colour which have been inadequately researched. If the situation is not addressed mushroom industry in Kenya will collapse. Therefore, this study sought to examine the effect of mushroom characteristics on performance of oyster mushroom enterprise. The research question for the study: To what extent do mushroom characteristics affect performance of Oyster mushroom enterprise?

Significance /contribution of the study

i)Policy makers

The study will benefit both County Governments and National Government in policy formulation. Therefore, the policy makers will use the information or result and make relevant policies such as creation of incentives to mushroom growers

ii) Mushroom farming Community

The expansion of mushroom will create self-employment to job seekers. Instead of migrations to urban areas in search of white-collar jobs, most people will be engaged along the mushroom value chain. Mushroom enterprise utilizes agricultural wastes as substrates (growing medium), this can be a source of income to farmers not directly engaged in mushroom production but on other agricultural activities. They will sale agricultural wastes to mushroom growers.

iii) Scholars and researchers

The knowledge which has been created is useful to scholars and researchers who are in need of new ideas for their researches or studies. Mushroom enterprise is unique from vegetables and animals, therefore presents unique opportunities to scholars and researchers to develop new and more theories in science and arts.

Theoretical framework

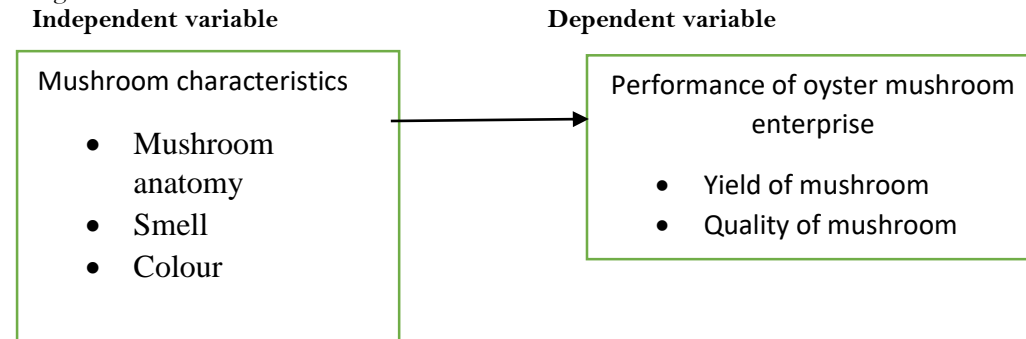
The study has been anchored on Need for Achievement Theory (NAT). This theory was authored by [16]. It focuses on human values and motives which are responsible to make an entrepreneur to exploit opportunities and take advantage of favourable trade conditions. The achievement guides the actions of the entrepreneur and those with high need for achievement behave in an entrepreneurial way. Achievers like solving problems and achieve goals.

Relevance of the theory

The theory is relevant to this study because there is an opportunity of growing a unique enterprise whose benefits are many to mankind emanating from nutritional and medicinal values. The mushroom growers set objectives and develop plans such as strategic plan and operational plan so that objective is met. The theory of (NAT) can assist mushroom growers to remain focused and be motivated by achievement. Some of the key qualities of entrepreneurs are risk taking, systematic planning and goal orientation

Conceptual framework

The conceptual framework shows independent (Predictor) variables and dependent (Response) variable as shown in figure 1.



Source: Researcher, 2021

Figure1. Interaction between independent and dependent variables

Literature review

Mushrooms are classified under fungi kingdom and the evolution is from algae. They are neither true vegetables nor animals [2]. They are heterotrophic in nature, incapable of synthesizing their own organic materials. The major components of the global mushroom industry are edible, medicinal and wild mushrooms [17]. The poisoning incidents of mushroom have been reported and identification of mushroom species responsible for poisoning is an issue of great concern [15]. The highest rate recorded of correct identification of mushroom is at 17% [15]. Therefore the need to study mushroom characteristics to equip both consumers and producers with skill and knowledge on identification of the edible and inedible mushrooms. Mushrooms can differ in appearance, nevertheless generally they are differentiated using mushroom anatomy, smell and colour. Anatomy parts include stipe, pileus, lamellae and annulus as shown in figure 2.

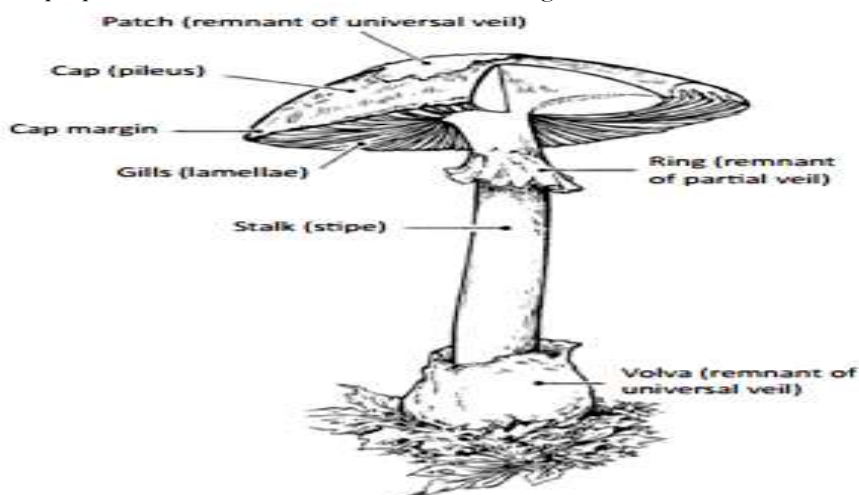


Figure 2. Mushroom anatomy

Brief description of mushroom anatomy

i) Pileus (Cap)

The pileus is also called cap. It can be described as cup-shaped, conical or round and could be smooth or covered with some small nibs.

ii) Stipe (Stem or stalk)

The stipes is also known as stem or stalk. The stem extends from the cap to the growing medium known as substrate. It can be long and slender or short and fat. The stem could be hollow or not. Not all mushrooms have a stem.

iii) Lamellae (Gills)

The Lamellae is referred to as gills and produces the spore which is part of the mushroom. Gills are found on the underside of the cap and may consist of a large number of small holes.

iv) Annulus (Ring)

Annulus is also called ring. It's a vestige of the universal veil the mushroom has to break through as it sprouts.

v) Volva

The volva is a bulging section at the base of the stem. It is found at the bottom or underground.

In India, slow growth in mushroom industry has been experienced which might have been caused by inadequate knowledge on mushroom characteristics, poor cultivation methods and depressed markets especially at glut phase [9]. [5], indicates that mushroom as an enterprise has been ignored, neglected and marginalized, perhaps due to insufficient knowledge to demystify mushroom characteristics. The cultivated mushroom varieties are about 30 globally [8] while in Kenya only two varieties namely Button and Oyster are cultivated [10]. [18] in their study indicated that Oyster mushroom is preferred especially by beginners because of being able to utilize wide range of agricultural wastes as substrate. [2], have indicated that more people are experiencing problems when feeding on unidentified mushrooms, therefore knowledge on mushroom characteristics for proper identification between edible and inedible mushrooms is crucial for safety to all consumers. The key characteristics of mushroom consists of those parts of mushroom by describing either the colour or smell of mushroom anatomy. The common components for scrutiny include stipe, pileus, lamellae, annulus and volva [19, 20, 21]. Good understanding of these characteristics and positive identification between edible and inedible or poisonous mushrooms will help in the expansion of mushroom industry globally, regionally, nationally and locally either at subsistence or commercial scales. [19], in his study found that most of edible mushrooms possess stipes (stem or stalk), pileus (cap) and lamellae (gills). Also, those with annulus (ring) and volva are poisonous. [20], studied characteristics of mushroom and found that identification of edible and inedible mushroom was not easy. The main features of identification of poisonous variety of mushrooms include lamellae, pileus and stipes. The mushrooms with white lamellae (gills) are often poisonous. Those with pileus (cap) having a red colour are inclined toward inedible category. And the mushrooms with stipes which is red are equally classified as poisonous. He further identified smell as an indicator of poisonous mushroom. Any mushrooms with unpleasant acrid smell are poisonous. Mushroom can be deceptively beautiful and dangerous at the same time [20]. [21], also cited stipes, Pileus and lamellae as identifiable features of edible mushrooms. The lamellae should be dark for edible mushroom while white lamellae indicate poisonous mushroom or toxic species. The mushrooms with red stripes, red pileus, and with acrid smell belong to poisonous species.

Research Methodology

The study employed descriptive research design which helps to describe the situations as it exists [22]. The study population was 300 mushroom growers and a sample of 30 representing 10% of the respondents were involved in the study. The cluster/area random sampling technique was utilized in this study due to dispersed population in different locations of Mumias division [23]. The data was collected using mainly questionnaire and also observation. Reliability of the research instrument was tested by conducting pilot study using 10 respondents, face validity and content validity were improved by use of experts. The data was analyzed using descriptive statistics with help of Statistics Package for Social Sciences (SPSS) and findings were presented in tables.

RESULTS AND DISCUSSION

Gender of respondents

The finding showed that 16(53.3%) females and 14(46.7%) males participated in the study. The implication is that more females are involved in Oyster mushroom farming than males (Table 1)

Table 1. Gender distribution

Gender	Frequency	Percent (%)	Cumulative (%)
Male	14	46.7	46.7
Female	16	53.3	100.0
Total	30		

Source: Field data, 2021

Age of respondents

The result showed that 5 (16.7%) of respondents were aged between 18 and 25 years, an equally number, 5(16.7%) were aged between 25-33, and 10(33.3%) were from 34 to 41 years and also above 41 years were 10(33.3%). This means that youths were 10 (33.4%) while older people were 20(66.6%). The business of mushroom farming seems to attract old people more than young people (Table 2)

Table 2. Age distribution of respondents

Age (Years)	Frequency	Percent (%)	Cumulative (%)
18-25	5	16.7	16.7
26-33	5	16.7	33.4
34-41	10	33.3	66.7
Above 41	10	33.3	100.0
Total	30		

Source: Field data, 2021

Experience of in mushroom farming

Large number of mushroom growers have experience of less than one year (23/76.7%). This implies that a total of 153 mushroom growers in Mumias division are inexperienced and can easily drop out of mushroom enterprise if they encounter challenges which they cannot withstand. Few are having experience of 2-4 years in mushroom farming (6/20%). This means 40 growers have reasonable experience, however, most of SMEs are known to fail within five years, therefore this is a critical time which will determine whether one will remain in the enterprise or quit (Table 3). Those with experience of more than five years are very few (1/3.3%). This implies that 7 growers have been tested and can be relieved upon for planning purpose. They have passed critical mass failure stage of an enterprise.

Table 3. Experience in mushroom farming

Years	Frequency	%	Cumulative (%)
Less than 1	23	76.7	76.7
2-4	6	20.0	96.7
More than 5	1	3.3	100.0
Total	30	100.0	-

Field data, 2021

As per the findings, only one type of variety or species of mushroom is found here, Oyster mushroom (*Pleurotus spp*). The rationale for this mushroom is that it is easy to grow on varied substrates, spawn availability and growers were unaware of any other variety. The easiness of adaption of oyster mushroom is in agreement with [18], in their study reported that oyster is easily grown by beginners. Also, the result supports [24] who reported that Oyster mushroom is cultivated by majority of mushroom growers. The study found that Oyster mushroom particularly stipe (Stem) Pileus (Cap) and lamellae (Gills) had grey colour and nice smell which is likened to chicken meat. This colour contradicts the report of [21] who indicated that lamellae have a dark colour for edible mushroom while the finding on smell is in agreement with the report of [20] which indicated that any mushroom with unpleasant acrid smell is poisonous. As per observation, it was not easy to identify edible mushroom from inedible especially for wild mushrooms. Older people used observations technique do identification, if rodents had not eaten mushrooms, then it belongs to poisonous class or category.

CONCLUSION

The research findings pointed out that the attributes of mushrooms significantly impact the performance of the oyster mushroom enterprise. Mushroom growers primarily rely on two characteristics, namely smell and color, to distinguish between edible and inedible varieties. Interestingly, even when considering color, growers struggle to

correlate it with specific mushroom parts like stipe, pileus, lamellae, annulus, or volva. Furthermore, the study concluded that oyster mushrooms were the exclusive variety cultivated throughout Mumias division. Additionally, a noteworthy majority of mushroom growers lacked sufficient experience in mushroom cultivation, with less than one year of practical involvement.

RECOMMENDATIONS

The study recommended the following:

i)Introduction of new varieties

In the whole division oyster mushroom is the only variety which is cultivated even button grown elsewhere in Kenya is not grown here. Therefore, this study recommends introduction of more than two varieties of mushroom to boost production in this geographical area.

ii)Establishment of Mushroom Training Institute (MTI)

The mushroom Training Institute will train growers on entrepreneurial skills necessary to manage this enterprise in holistic manner. This should in a long-term project aimed at sustainability of mushroom enterprise.

iii) Mushroom training

For short and medium outcomes, the County Government and National Government should conduct intensive training on mushroom characteristics so as to identify edible mushroom from inedible particularly on wild mushrooms. The wild mushroom can make a positive contribution towards supply of mushroom and help to reduce existing gap between production and consumption demand. This is meant to assure consumers that available mushrooms are fit for consumption.

iv)Development of incentive schemes

Development of incentive schemes should aim at attracting and encouraging young people to mushroom enterprise so that they are self-employed. The mushroom value chain when well utilized can create a lot of jobs.

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CITE AS: Andrew, O. Nyakundi (2023). The Impact of Mushroom Characteristics on the Performance of Oyster Mushrooms among Small-Scale Farmers: A Study in Mumias Division, Mumias Sub-County, Kenya. NEWPORT INTERNATIONAL JOURNAL OF CURRENT RESEARCH IN HUMANITIES AND SOCIAL SCIENCES 3(2):65-71.