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WILD AND DOMESTICATED MUSHROOM CONSUMPTION IN NIGERIA

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ABSTRACT

Research on mushroom and mushroom products is dynamic with global increasing interest. The natural habitat of mushrooms being the wild, it is imperative to cultivate mushroom domestically in order to make it available to the populace. The aim of this research was to assess the perception of consumers to consumption of wild and cultivated mushrooms in Port-Harcourt, Nigeria; and validate nutrition quality of wild and cultivated mushroom. A survey was conducted using structured mixed questionnaires, to gather perception of 90 respondents on consumption of wild and cultivated mushroom. *Lentinus squarrosulus* (Mont.) Singer, sourced from the wild was cultivated using standard methods for mushroom cultivation and both mushrooms were analysed for proximate chemical and mineral components. Result revealed that 47.8% of the respondents got introduced to mushroom consumption through family settings; 53.3% of respondents were conversant with wild mushrooms, 27.8% with cultivated and 16.7% with both. A total of 71.1% was informed about mushroom poisoning; while 28.9% had no knowledge about it at all. About 45.6% sourced mushroom from the wild and 33.3% from mushroom farms. Only 28.9% consumed mushrooms for over 10 years; whereas, 13.3% had never tasted mushrooms. Year-round consumption was only by 12.2%; while 57.8% consumed mushroom once in a while. However, if cultivated mushrooms could be made available, 58.9% indicated interest in mushroom consumption. If nutrition facts of wild and cultivated mushrooms are the same, 38.9% were willing to consume cultivated mushrooms, 30.0% wild, 20.0% both and 11.1% insisted on no consumption. On the other hand, if nutrition analysis reveals different nutrition parameters for both types of mushrooms, 43.3% opted for cultivated mushroom, 42.2%, wild; 12.2% both; while 2.2% would eat neither of the mushrooms. Generally, from the results, both mushrooms possess adequate nutritive values; though, of all the parameter analysed, only zinc was significantly different ($P<0.05$). For some of the parameters (potassium, zinc, phosphorus, calcium, total ash, crude fat, crude protein) the wild mushroom had higher values than the cultivated; whereas for other parameters (iron, manganese, magnesium, carbohydrates, crude fiber), the cultivated values were higher. Both mushrooms were relatively low in fat, ash and moisture; and high in carbohydrate, crude fiber and crude protein. Both mushrooms were high in minerals. There is no significant difference between the nutrition facts of the wild and cultivated test mushrooms.

Key Words: Consumption pattern, *Lentinus squarrosulus,* nutrition, perception, wild mushroom

RÉSUMÉ

La recherche sur les champignons et les produits derivés est dynamique avec un intérêt croissant mondiale. L'habitat naturel des champignons étants auvage, ils'avère impératif de domestiquer les champignons afin de le rendre disponible à la population. L'objectif de cette recherche était d'évaluer la perception des consommateurs à la consommation de champignons sauvages et ceux cultivés à Port-Harcourt, au Nigeria; et de valider la qualité nutritionnelle des champignons sauvages et cultivés. Une enquête étaitmenée à l'aide d'un questionnaire mixte structuré, afin de recueillir la perception de 90 répondants sur la consommation de champignons sauvages et

cultivés. *Lentinus squarrosulus* (Mont.) Singer, d'origines auvage était cultivés en utilisant des méthodes standard pour la culture des champignons et les deux analysés pour obtenir des données sur leurs composants chimiques et minéraux. Les résultats d'analyse ont révélé que 47.8% des répondants étaient déjà habitués à la consommation de champignons au niveau familial, 53,3% étaient familiarisés aux champignons sauvages, 27,8% les cultivaient chexeux et 16,7% étaient familiers aux deux. Au total, 71.1% ont été informés de l'intoxication par les champignons; tandis que 28.9% ne connaissaientrien à cesujet. Environ 45.6% de champignons consommés étaient de source sauvage et 33.3% cultivés chez eux. Seuls 28.9% consommaient déjàles champignons depuis plus de 10 anstandis que 13.3% n'avaient jamais mangéles champignons. La consommation annuelle était seulement 12.2% pendant que 57.8% consommaient les champignons occasionnellement. Toutefois, si les champignons cultivés pouvaient être disponibles, 58.9% ont indiqué leur intérêt à consommer les champignons. Si les preuvessur la nutrition par les champignons sauvages et les champignons cultivés sont les mêmes, 38,9% souhaitaientc onsommer les champignons cultivés, 30,0% sauvages, 20,0% et 11,1% ont insisté sur la non-consommation. D'autre part, si l'analyse nutritionnelle révèle des paramètres nutritionnels différents pour les deux types de champignons, 43,3% préféraientles champignons cultivés, 42.2% les sauvages; 12.2% les deux, tandis que 2.2% ne préféraientaucun des deux. D'une manière générale, les résultats indiquent que les deux types de champignons possèdent des valeursnutritivesadéquatesbien que de tous les paramètres analysés, seul le zinc était significativement différent ($P < 0.05$). Pour certainsdes paramètres (potassium, zinc, phosphore, calcium, cendretotale, graisse brute, protéine brute), les champignons sauvages présentaient des valeurs plus élevées que celles cultivées alors que pour d'autres paramètres (fer, manganèse, magnésium, glucides, fibres brutes), les champignons cultivés presentaient des valeurs les plus élevées. Les deux champignons étaient relativement faibles en matières grasses, cendres et de l'humidité et riche en hydrate de carbone, en fibres et protéines brutes. Encore plus, les deux champignons étaient riches en minéraux. Il n'y a pas de différence significative entre les faits nutritionnels des champignons sauvages et cultivés testés.

Mots Clés: Consommation, *Lentinus squarrosulus*, nutrition, perception, champignon

INTRODUCTION

Research on mushroom cultivation and usage is dynamic, with new discoveries unfolding by the day. This unique vegetable is increasingly global in demand. Recent research reported various uses of the crop (Summers *et al*., 2015; Singdevsachana *et al*., 2016; Bemas and Jaworska, 2016; Robak *et al*., 2016). Mushrooms have their natural habitat in various places, ranging from farm lands, forest and newly cleared lands, to cut pieces of wood found in several places.

In these natural habitats, availability of mushrooms is seasonal, depending on the species; some may be available just at the onset of rains, others during the rains; yet others when the rains are winding up. This leaves a gap for lovers of mushrooms during dry season or summer period, and underscores the need for mushroom cultivation (domestication).

Furthermore, there are risks associated with mushroom hunting, the greater one being mushroom poisoning which could cause various discomfort ranging from mild/severe gastrointestinal disturbances to outright death (Stamets, 2000).

Mushroom cultivation is the conversion of agricultural wastes to useful products of various uses using tissue culture techniques. Agricultural wastes, which otherwise would have been burnt or constitute a nuisance to the ecosystem (Bano *et al.,* 1993; Buswell *et al*., 1996; Cohen *et al*., 2002) become useful to produce useful vegetables suitable for all gender classes.

Mushroom cultivation dates back to the 17th Century (Anonymous, 2016) and had since made tremendous improvements to-date. Although mushroom cultivation and consumption are globally being encouraged, with new products being introduced and formulated, there is a perception among many

consumers of mushrooms in Nigeria that cultivated mushrooms are not as nutritious as wild mushrooms. This is often believed, and affects consumption behavior of cultivated mushroom. The aim of this study was to assess perception of consumers of wild and cultivated mushroom; and then scientifically evaluate the nutrition facts of both wild and cultivated mushrooms.

MATERIALS AND METHODS

Lentinus squarrosulus was sourced from Aluu village, in Port-Harcourt, Rivers State in Nigeria. The mushroom was found growing on dead *Gmelina arborea*, a hardwood commonly known as beech wood or white teak. Tissue culture and spawn of the mushroom were carried out using modified standard methods (Stamets, 2000; Oie, 2016). The mushroom was cultivated on sawdust of *Khaya ivorensis* and *Gmelina arborea* obtained from a local sawmill. Using a mixture of sawdust, rice bran and lime as bulk substrate in the ratio 10:1:0.2, *L. squarrosulus* sourced from the wild was produced.

Mushroom consumption. A survey was conducted in Port-Harcourt, Nigeria using convenience sampling methods. Structured mixed format questionnaires were administered to assess awareness and perception to wild and cultivated mushroom consumption. Key parameters in the questionnaire included biodata, awareness about edible and poisonous mushrooms, mode of awareness, consumption history, wild or cultivated preferences, among others. Responses from 90 respondents were used for the purpose of this research. Of this number, 73.4% were civil and public servant. Up to 15.6% were students and 11.1% business owners.

Data analysis. Descriptive statistics such as frequency counts, means and percentages were employed to describe parameters in the questionnaires.

Proximate chemical and mineral analyses. The originally wild mushroom as well as the cultivated mushroom were analysed for proximate chemical and mineral contents. Proximate chemical composition was determined using standard methods as described by Barros *et al*. (2008). Minerals (Ca, Mg, K, P, Mn, Fe and Zn) were determined using procedures for determination of micro- and macro- elements in food and feed samples, with the aid of Atomic Absorption Spectrophotometer (AAS) (García *et al*., 2008).

Data obtained were analysed statistically using analysis of variance (ANOVA) procedure of SAS Statistical Software Package (2001).

RESULTS

The survey. Table 1 and Figure 1 display responses from the respondents. The Table also shows the geographical spread of the respondents, along the four regions of Nigeria, namely: northern, southern, eastern, and western regions. Only two of the respondents had not heard of mushroom before the questionnaire was administered to them. The mode by which individuals got introduced to mushroom consumption varied (Fig. 1); however, awareness through family members was 31.1% higher than that from friends; and 46.7% higher than awareness through religious affiliation, which was the least.

Figure 1 further revealed responses in the order of 53.3% conversant with wild mushrooms, 27.8% with cultivated mushrooms, and 16.7% with both wild and cultivated mushroom. Up to 71.1% were informed about mushroom poisoning; while 28.9% were unaware about this characteristic. A total of 45.6% mushrooms were sourced from the wild and 33.3% from mushroom farms. Only 28.9% had been consuming

TABLE 1. Bio-data for respondents and source of mushroom information in a study in Nigeria

	Frequency	Percentage (%)
Age (years)		
15-25	12	13.3
26-35	22	24.4
36-45	32	35.6
46-55	19	21.1
>56	5	5.6
Sex		
Male	58	64.4
Female	32	35.6
Religion		
Christian	85	94.4
Islam	5	5.6
Occupation		
student	14	15.6
public servant	66	73.4
Business	10	11.1
Region		
North	9	10.0
South	44	48.9
West	18	20.0
East	19	21.1
Informed about mushroom		
Yes	88	97.8
No	2	2.2
Mode of information		
Internet	3	3.3
Family	43	47.8
Farming	6	6.7
Media	4	4.4
Excursion/seminar	6	6.7
Study	7	7.8
Friend	15	16.7
Religious affiliation	1	1.1
N/A	5	5.6

NA = Not applicable

mushrooms for over 10 years; whereas 13.3% had never tasted mushrooms.

Year-round consumption was only 12.2%; while 57.8% consumed mushroom once a while. However, if cultivated mushrooms could be available to households, 58.9% indicated interest in mushroom consumption. On the other hand, if nutrition facts of wild and cultivated mushrooms were the same, 38.9% were willing to consume cultivated mushrooms, 30.0% wild, 20.0% both and 11.1 insisted on no consumption. However, if nutrition analysis reveals different nutrition parameters for both mushrooms, 43.3% opted for cultivated mushroom, 42.2% wild, 12.2% both; while 2.2% would eat neither of the mushrooms. Reasons for choice of wild or cultivated mushroom for consumption are represented in Table 2.

Reasons gathered for discontinuation of mushroom consumption from the 27.8% respondents who had had to stop mushroom consumption included loss of interest (24.0%), unavailability –seasonal/insufficient supply for cultivated (68.0%), mushroom poisoning (4.0%) and expensive cost of cultivated mushroom compared with free wild mushrooms (4.0%).

Nutrition analysis. Results for nutrition parameters for both wild and cultivated mushrooms are represented in Tables 3 and 4. Generally, both mushroom types possessed adequate nutritive values, though, there was no significant difference ($P>0.05$) between parameters analysed for proximate facts. However, for minerals, only zinc was significantly different ($P<0.05$). For some of the parameters (Table 4), the wild mushroom had higher values than the cultivated. For other parameters (iron, manganese, magnesium, carbohydrates and crude fiber), the cultivated values were higher. Both mushroom types were relatively low in fat, ash and moisture, but higher in carbohydrate, crude fiber and crude

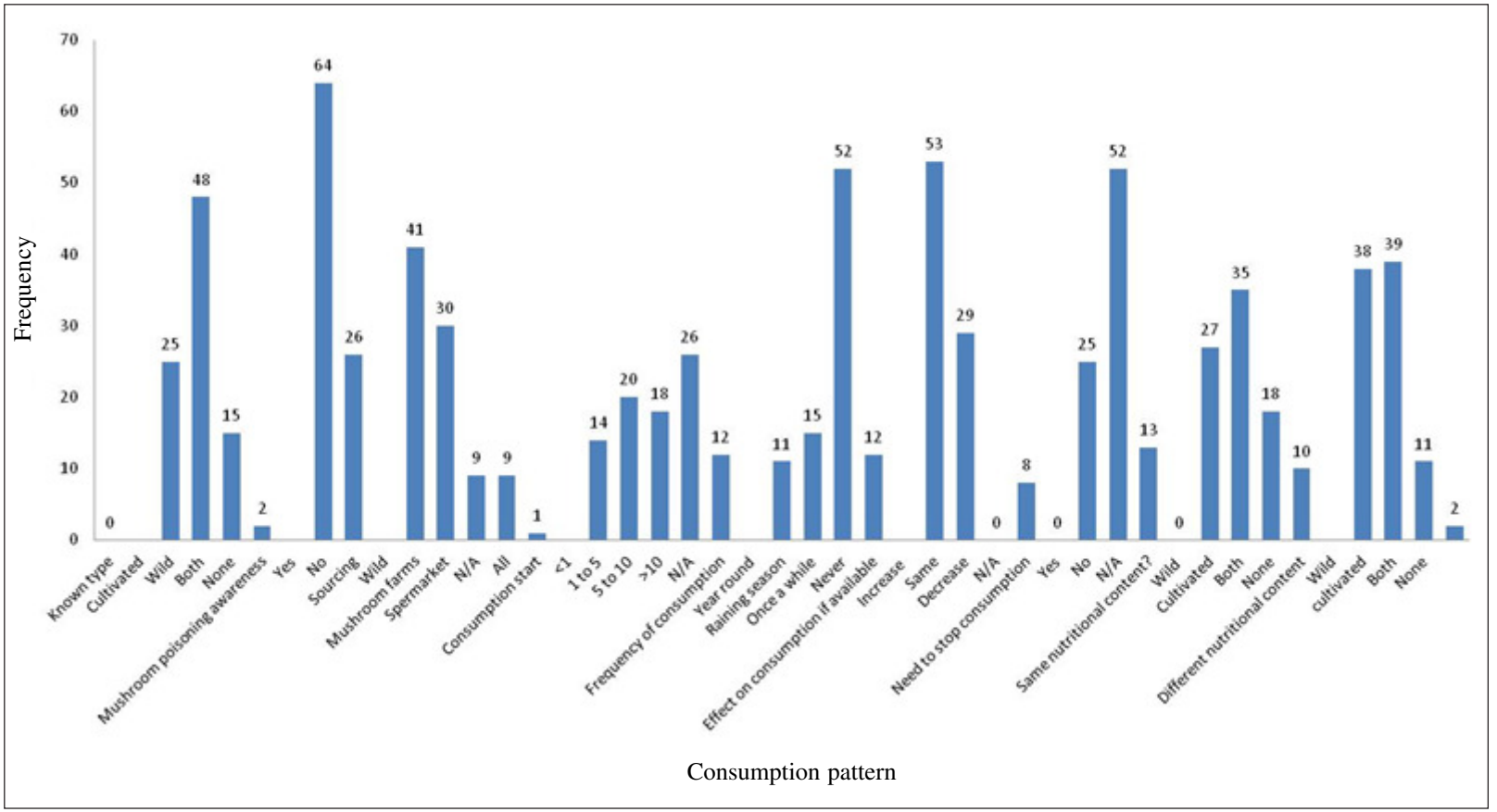

Figure 1. Consumption history of wild and cultivated mushrooms in Nigeria.

TABLE 2. Reasons for preference of wild or cultivated mushroom by communities in Nigeria

Wild	Cultivated	Both
Natural	Safety and health	Nutritious
Less expensive	Reliable source	Medicinal
Nutritious	Hygienic	
Delicious	*May contain hazardous chemicals	
Freshness	Nutritious	
Tastier	Readily available year round	
Absence of additives	Natural taste	
Organic	Easy access to commercial farm	
May be harvested free	*May be genetically modified Free from poisonous chemicalswhich may be present on sites where wild mushrooms are sourced Medicinal Mere interest May be easily fortified	

* Addressed in discussion

TABLE 3. Proximate chemical composition of wild and cultivated *Lentinus squarrosulus* in Nigeria

Mushroom	Moisture (%)	Crude protein (%)	Crude fat (%)	Crude fiber (%)	Total ash (%)	CHO (%)
Wild	10.820±0.10	23.34±3.44	3.96±0.57	24.29±2.63	7.53±1.75	30.60±2.55
Cultivated	11.57±0.49	22.56±0.56	3.12±0.47	25.34±0.93	7.37±0.21	31.00±0.06
T-test	1.85	0.22	1.12	0.38	0.09	0.16
(P>0.05)	0.11 ^{NS}	0.83 ^{NS}	0.31^{NS}	0.72 ^{NS}	0.93 ^{NS}	0.88 ^{NS}

NS = Not significant

protein (Table 3). Results for minerals (Table 4) indicated that both mushrooms are high in minerals

DISCUSSION

Bio-data of respondents showed their distribution across age, gender, religion and occupation are presented in Table 1 and Fig. 1). The fact that all age and gender groups involved in this study indicated mushroom awareness, buttressed the fact that mushroom consumption in Nigeria is gaining recognition and becoming a subject of interest (Adedokun *et al*., 2016). Only two persons out of the 90 respondents had no knowledge about mushrooms. The influence of family and friends in mushroom consumption was evident in rejoinders, however; mushroom growers may need to engage in the use of other means

TABLE 4. Mineral composition of wild and cultivated mushrooms in Nigeria

Treatments	Ca (mg kg^{-1})	Mg (mg kg^{-1})	K (mg kg^{-1})	P (mg kg^{-1})	Mn (mg kg^{-1})	Fe (mg kg^{-1})	Zn (mg kg^{-1})
Wild	7.84±14.55	2.95±135.80	3.24±3459.39	6.28±158.9	1.57±1.01	1.99±4.46	5.57±2.99
Cultivated	5.79±4.65	3.13±66.60	2.17±5868.70	6.07±147.16	1.68±0.83	2.23±15.02	4.09±1.06
T-value	1.34	-1.18	1.57	0.97	-0.86	-1.56	4.66
(P>0.05)	0.23	0.28	0.17	0.37	0.43	0.17	0.003

such as internet, media, seminars and workshops to launch a better campaign.

Knowledge about wild mushroom was higher than cultivated mushroom (Fig. 1). This is understandable as mushrooms have their natural habitat in the wild. Nevertheless, since availability of wild mushroom is seasonal and may have attendant risks, awareness about cultivated mushrooms should be widely publicised. It may be necessary to keep the populace up to date with information about mushroom poisoning as the percentage of individuals who did not have this information is relatively high. This could promote mushroom cultivation.

It is quite interesting to know that about 33.3% of respondents obtained mushrooms from commercial farms; this reinforces the fact that mushroom farming is gradually growing (Adedokun *et al.*, 2016). Consumption history revealed that, although a large proportion (71.1%) of respondents had knowledge about mushroom consumption, only a few (12.2%) consumed it year-round. A greater percentage (57.8%) consumed it once in a while. There is, thus need for basic awareness about nutritional benefits from mushrooms. This will raise the knowledge of individuals and enable more persons to partake of the benefits mushrooms possess.

Awareness may furthermore be necessary, considering the reasons stated for preference of wild over cultivated mushrooms (Table 2). Some respondents expressed concern that cultivated mushrooms may contain hazardous chemicals, and may be genetically modified. These views are not necessarily the case as use of hazardous chemicals is not encouraged in mushroom cultivation and not all cultivated mushrooms are genetically modified. There may be a need for regulatory bodies to monitor mushroom cultivation process and ensure compliance to standards.

It is remarkable to note that approximately 60% of respondents were willing to increase mushroom consumption, provided mushrooms were readily available (Fig. 1). This is good news to commercial mushroom growers, who

could produce mushroom year-round as well as promote mushroom farming and cultivation. Also, individuals who had stopped mushroom consumption, mainly for non-availability of the product, may resume consumption of produce with availability.

Nutrition facts of wild and cultivated being the same, cultivated mushroom was preferred over wild mushroom due to health and safety issues, as well as year-round availability, among other reasons. This underscores the need to improve upon commercial mushroom production. Even in the event that nutritional composition was different, cultivated mushrooms were still preferred, although the line of preference was thin (Fig. 1).

Analysis of wild and cultivated mushrooms for proximate chemical composition indicated the two mushrooms were equally nutritious (Tables 3 and 4). This corroborates with the work of several workers (Kadiri and Fasidi, 1992; Barros *et al*., 2008; Okhuoya *et al*., 2010; Ahad *et al*., 2014; Valverde *et al*., 2015) who reported that mushrooms are rich in nutrients. Interestingly, the wild mushroom did not possess more than one of the analysed parameters in proportions significantly different from the cultivated ones. Analysis was, however, limited to proximate chemical composition and mineral analyses. This should allay fears by concerned individuals that cultivated mushrooms are less nutritional than wild mushrooms. This observation is similar to that of Barros *et al.* (2008) that wild and cultivated mushrooms possess essential nutrients. While the wild mushroom was higher in crude protein, crude fat, total ash, calcium, potassium, phosphorus and Zinc; the cultivated mushroom possessed higher values in moisture content, crude fiber, carbohydrate, magnesium, manganese and iron, although, in this study, the cultivated mushroom was produced from its wild counterpart.

CONCLUSION

There is no significant difference between the nutrition facts of the wild and cultivated test mushroom. It is anticipated that the findings of this research will positively influence the perception of mushroom consumers, improve their buying behavior and the market size.

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