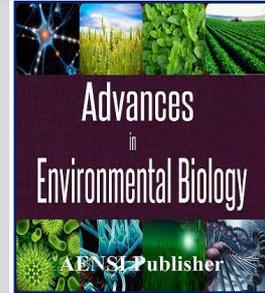




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State of the Art of Mycophagy in Los Rios, Ecuador

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ABSTRACT

This paper is the first report on ethnomycology and mycophagy among the local people of Los Rios, Ecuador even though the country is one of the mega biodiverse countries in the world. Due to the lack of scientific information along these topics, our research team initiated the generation of baseline data on the utilization and consumption of mushrooms by the locals. Mycoexpedition was conducted between December 2015 to early part of January 2016 in order to gather information on mushroom utilization and consumption among the local people in the target areas. Survey questionnaire which was supported by focus group discussion was administered to the respondents (n=60). Results of the investigation revealed that there is a relatively higher level of knowledge by the local people regarding the nature of mushrooms where they considered mushrooms as edible (>40%) that appear mostly during rainy season (90%) on rotting logs (>50%). Most (53.19%) of the respondents prefer to consume mushrooms primarily as food ingredients. Majority (76.92%) expressed their interest to cultivate mushrooms, but the unavailability of production technology prevented them from doing so. Thus, from the very vital information obtained from this investigation, there is a need to identify the mushroom flora in the target areas, rescue their secondary mycelia and develop production technology for the inhabitants of Ecuador.

KEYWORDS: Los Rios mushrooms, Mushroom consumption, Mushroom utilization, Mycophagy

INTRODUCTION

Mushrooms have been recognized since time immemorial as important part of the human diet. People preferred to consume mushrooms because of their strong aroma and good texture which may be comparable to animal-based protein. In recent years, due to the inherent health benefits that mushrooms possess which have been supported by scientific evidences [1, 2, 3], these important commodities have attained a new image in the market i.e. from being ordinary culinary ingredients to nutraceuticals or functional foods. They have been reported to possess bioactive compounds with functionalities [4, 5].

Ecuador is one of the megabiodiverse countries in the world which is located in the western side of South America between Colombia, Peru and Brazil. It is divided into three main natural regions i.e. the coastal plain fronting the Pacific Ocean, the inter-Andean central highlands and the rolling eastern Amazonic forest having varied climate and vast vegetation [6].

Los Rios is one of the agricultural provinces in Ecuador where the main agricultural and forest commodities are banana, maize, rice, cacao, coffee and tick trees. Large amount of biomass in the form of agro-industrial

residues which are being generated from the production of these commodities can be tapped as substrates for mushroom production.

This paper is the first report on the knowledge, attitude and perception of the local people of Los Rios, Ecuador on ethnomycology [7] and mycophagy – consumption and utilization of mushroom. Also the current situation, challenges and prospects of mushroom production activities are also presented.

MATERIALS AND METHODS

Mycoexpedition in selected areas (Vinces, Montalvo and Clementina) of Los Rios, Ecuador was conducted in December 2015 and early part of January 2016.

Focus group discussion which was facilitated by survey questionnaire was done among the local people (n=60) of Los Rios on their knowledge, attitude and perception regarding utilization and consumption of mushroom. Their traditional beliefs, attitudes and perceptions toward mushrooms were also determined.

RESULTS AND DISCUSSION

Socio-demographic profile of the respondents:

Table 1 shows the socio-demographic profile of the respondents. Most of the respondents who are mostly married (74.60) belong to the age bracket between 20-27 years old (48.33%). Majority finished secondary education (33.33%) while 1.59% of the respondents graduated from elementary. The family size ranges from 4-5 members per household which contributed to 25-27% of the respondents who are original settlers of Los Rios. Most of the respondents had an annual income of less than US\$5,000.00.

Table 1. Socio – demographic profile of the respondents (n=60)

Parameters	% Frequency
<i>Age bracket (years)</i>	
17-19	26.67
20-27	48.33
30-39	15.00
40-50	10.00
<i>Civil status</i>	
Single	25.40
Married	74.60
<i>Level of education</i>	
Graduated from college	14.29
Still pursuing college	23.81
Graduated from vocational school	20.63
Graduated from high school	33.33
Did not finish high school	6.35
Graduated from elementary school	1.59
<i>Total number of members in a household</i>	
2	5.45
3	12.73
4	25.45

5	27.27
6	12.73
7	9.09
8	7.27
<i>Annual income (in US\$)</i>	
50,000 or more	0
31,000-40,000	1.67
21,000-30,000	5
11,000-20,000	15
5,000-10,000	10
Less than 5,000	68.33
<i>Nature of inhabitation</i>	
Natives	100
Migrants	0

Knowledge, attitude and perception on mushroom utilization and consumption:

Sixty five percent of the respondents know about mushrooms as depicted in Table 2. They have a clear understanding about the nature of this group of organisms. Majority of the respondents considered mushrooms as edible (40.54) while 21.62% regarded them as poisonous. The respondents have a clear understanding about the nature of mushroom as an organism which acts as a saprophyte or plant pathogen. Ninety percent of the respondents believed that mushrooms usually come out during rainy season on rotten logs (59.15%), soil (18.31%) as well as on decomposing piles of leaf litters (14.08).

Table 2: Knowledge of the respondents on mushrooms (n=60)

Parameters	% Frequency
<i>Having knowledge about mushrooms</i>	
Yes	65
No	35
<i>What do you know about mushrooms?</i>	
Mushrooms	30.49
Microorganisms	24.39
Fungi	17.07
Plants	7.32
Poisonous	7.32
Recycling organisms	4.88
Plant pathogens	3.66
Alternatives for agriculture	2.44

Organisms without chlorophyll	1.22
Cause sickness	1.22
<i>What is the nature of mushroom?</i>	
Edible	40.54
Poisonous	21.62
Saprophytes	10.81
Plant pathogens	8.11
Deuteromycetes	5.41
Ascomycetes	5.41
Basidiomycetes	5.41
Umbrella-like	2.70
<i>At what time of the year do mushrooms usually come out in the wild?</i>	
Rainy months	90
Dry months	6
Cooler months	4
<i>In what substrates do you usually observe the wild mushrooms?</i>	
On rotting logs/wood	59.15
On the soil	18.31
On decomposing piles of leaves	14.08
Anywhere	8.45

The data on the uses and consumption of mushrooms by the local people of Los Rios, Ecuador are presented in Table 3. The respondents mentioned that mushrooms are utilized as food sources, recyclers of the environment and as medicines. More than 80% of the respondents prepared mushroom as food by cooking which are usually sauteed (44.19%) with other vegetables (47.73%). Majority (75%) of the local people of Los Rios seldom consumed mushroom due to its seasonal availability both in the market and in the wild. However, wild mushroom belonging to the boletes group (Fig. 1) can only be gathered in the pine forest of the highland in Salinas de Guaranda which belongs to the province of Bolivar. Being mycorrhizal, it has symbiotic relationship with the roots of pine trees. It is the only wild mushroom known to be edible by the local people of Ecuador. On the other hand, the commercial species of cultivated mushrooms which are available in the supermarkets include *Pleurotus ostreatus*, *Lentinula edodes* and *Agaricus spp.* Due to these reasons, mushroom is not always available on the dining table of the local people of Los Rios despite of their preference to this commodity.



Fig. 1: Collection of *Suillus* sp. from the wild (upper photo, with arrow) showing the undersurface of the cap (lower photo).

Mushroom is being utilized by some local people (14.89%) as source of traditional medicine in treating stomach ache, coughs and colds, fever, muscle pain, tooth and head ache as well as deworming. Popular preparation of mushroom is by boiling and drinking its decoction (62.75%).

Table 3: Uses and consumption of mushrooms according to the respondents (n=60)

Parameters	% Frequency
<i>Uses of mushrooms</i>	
As food	53.19
As agent of recycling	31.92
As medicine	14.89
<i>Way of preparing mushroom as food</i>	
By cooking	83.33
Eaten as raw	10.42
Others (tea, etc.)	6.25
<i>Manner of cooking</i>	
Sautee	44.19
Grill	27.91
Stew	16.28

Paste	11.62
<i>Ways of cooking mushrooms</i>	
Mixed with other vegetables	47.73
Mixed with meat	31.82
Others (Fried)	11.36
As major ingredients	9.09
<i>Frequency of consuming mushroom</i>	
Seldom	75
Once a week	20
Twice or thrice a week	5
Everyday	0
<i>Volume of mushroom consumption?</i>	
Less than a kilogram in a year	66.67
Less than a kilogram in a week	33.33
<i>If mushroom is used as medicine, against what ailment?</i>	
Stomach ache	17.39
Cough and colds	13.04
Fever	10.87
Rheumatism/muscle pain	10.87
Toothache	10.87
Headache	6.52
Deworming	6.52
Do not know	23.91
<i>Preparation of mushroom as a traditional medicine</i>	
Boiled	62.75
Dried	17.65
Juice	9.80
Powder	7.84
Others	1.96

Traditional beliefs, attitudes and perceptions toward mushrooms:

The traditional beliefs, attitudes and perception of the local people of Los Rios are presented in Table 4. Majority of the respondents (84.91%) do not have traditional beliefs with regards to mushroom emergence, consumption and utilization not unlike with the other Latin Americans particularly Mexicans who believe that mushrooms are foods of the gods. The local people of Los Rios recognize mushroom based on its form and smell as well as its natural growing substrate. Though majority of the respondents (75%) know that mushroom

can be cultured, more than eighty percent did not have the opportunity to grow. One of the reasons is the unavailability of research-based production technology despite of the favorable climatic conditions and the ubiquity of substrates that can be tapped for production. The local people usually ignored mushrooms which are unfamiliar to them. Majority collect edible mushrooms from the wild in the morning primarily not for commercial reason (70%) where they emphasized that mushroom collection does not entail gender. Most of the respondents expressed their willingness to learn the technology of mushroom growing for they believe that it is a lucrative business undertaking.

Table 4: Traditional beliefs, attitudes and perceptions toward mushrooms (n=60)

Parameters	% Frequency
<i>Having traditional beliefs about mushrooms</i>	
Yes	15.09
None	84.91
<i>Way of recognizing if the mushroom is edible or not</i>	
Based on its form	38.60
Based on the substrate where it is growing	31.58
Based on its smell	12.28
Others	8.77
<i>Knowledge that mushrooms can be cultured</i>	
Yes	75
No	25
<i>Attempts of cultivating mushroom</i>	
Yes	11.54
No	88.46
<i>Usual behavior upon seeing unfamiliar mushrooms</i>	
Ignored	76.92
Destroyed	17.31
Others (merely watched)	5.76
<i>Selling of mushrooms collected from the wild</i>	
Yes	30
No	70
<i>Best person to collect mushrooms</i>	
Men	8.51
Women	12.77
Children	6.38
Grandparents	25.53
Anybody	38.60

<i>Having rituals prior to collection</i>	
Yes	0
None	100
<i>Time of mushroom collection</i>	
Morning	62.5
Noon	0
Afternoon	37.5
Night	0
<i>Willingness to learn mushroom culture</i>	
Yes	76.92
No	23.08
<i>Belief that mushroom growing is a source of livelihood</i>	
Yes	79.17
No	20.83

Current situation:

Los Rios is one of the provinces in Ecuador which is rich with diverse flora and fauna. Its lush vegetation and prevailing climatic conditions favor the proliferation of wild mycological resources including wild edible mushrooms. Different species of forest trees are cultivated together with major agricultural crops such as banana, coffee, corn, cacao, beans and rice. Among the wild edible mushrooms in the area which were encountered during the mycological expedition and with potential for commercial cultivation include: *Volvariella* sp., *Pleurotus* spp., *Auricularia* sp, *Ganoderma* sp and *Dictyophora* sp. (Fig. 2). There are 2 commercial farms that grow *Pleurotus*, *Agaricus* and *Lentinula* in the highlands of the nearby provinces of Pichincha and Azuay that satisfy the demand of the local supermarkets. Despite the ubiquity of substrates coupled with favorable climatic conditions for mushroom production, cultivation of mushroom is very limited due to the unavailability of research-based mushroom production technology.



Fig. 2: Some of the wild edible mushrooms with potential for commercial cultivation in Ecuador Legend: a. *Volvariella* sp. b. *Ganoderma* sp. c. *Auricularia* sp. d. *Pleurotus* sp. and e. *Dictyophora* sp.

Challenges and Prospects:

There is an under - utilization of agro-industrial and forest residues for mushroom production in Los Rios. Local agro-based industries generate vast amount of biomass that can be tapped as substrates for mushroom cultivation. Mushrooms generally grow on plant residues which are generally cellulosic [8]. Unfortunately, the absence of practical and innovative production technology prevent the local people from engaging in mushroom production despite of their strong interest. Thus, there is a need for the government to support a strong research and development program on the domestication of wild mushroom genetic resources that will ultimately result in the generation of practical, innovative mushroom production technologies which are applicable in the local setting. The challenge to capacitate both the researchers and local people on mushroom techno-transfer program is also deemed imperative.

Conclusion:

The local people of Los Rios, Ecuador are knowledgeable about the nature of mushrooms. Mushrooms are usually use for culinary purpose by the local people but their consumption of mushrooms is delimited by the supply in the local market. There is a bright prospect for mushroom cultivation in Los Rios thus efforts must be concerted from different stakeholders to support capacity building program towards a very strong research and development undertakings which will ultimately result in the development of mushroom production technologies suitable in Ecuador.

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REFERENCES

- [1] Dulay, R.M.R., A.A.C. Apolinar, R.C. Tiniola, S.P. Kalaw and R.G. Reyes., 2016. Aphrodisiac and diuretic activity of Philippine wild higher Basidiomycetes, *Ganoderma lucidum* (W.Curt.:Fr.) P. Karst., extract in male mice (*Mus musculus*). *Advances in Environmental Biology*, 10(1): 144-149.
- [2] Eguchi, F., S.P. Kalaw, R.M.R. Dulay, N. Miyazawa, H. Yoshimoto and R.G. Reyes., 2015. Nutrient composition and functional activity of different stages in the fruiting body development of Philippine paddy straw mushroom, *Volvariella volvacea* (Bull.:Fr.) Sing. *Advances in Environmental Biology*, 9(22): 54-65.
- [3] Dulay, RMR, K.S. Flores, R.C. Tiniola, D.H., Marquez, A.G. dela Cruz, S.P. Kalaw and R.G. Reyes. 2015. Mycelial biomass production and antioxidant activity of *Lentinus tigrinus* and *Lentinus sajor-caju* in indigenous liquid culture. *Mycosphere*, 6(6): 634-642.
- [4] Ragasa, C.Y., M.C.S. Tan, J. Ting, R.G. Reyes, R. Brkljaca and S. Urban, 2016. Chemical constituents of *Pleurotus djamor*. *Der Pharma Chemica*, 8(2): 343-346 .
- [5] Ragasa, C.Y., V.D. Ebajo Jr., R.G. Reyes, R. Brkljača and S. Urban, 2015. Sterols and lipids from *Pleurotus florida*. *Der Pharma Chemica*, 7(10): 331-336.
- [6] Dalmaso, E. and P. Fillon, 1972. Aspectos de la organización espacial del Ecuador, *Revista Mexicana de Sociología*, México D.F., 24(1): 75-94.
- [7] Albuquerque, U.P., J.S. Silva, J.L.A. Campos, R.S. Sousa, T.C. Silva and R.R. Nobrega, 2013. The current status of ethnobiological research in Latin America: gaps and perspectives. *Journal of Ethnobiology and Ethnomedicine*, 9: 72.
- [8] Reyes, R.G., F. Eguchi, S.P. Kalaw and T. Kikukawa, 2009. *Mushroom Growing in the Tropics: A Practical Guide*. Central Luzon State University Press. ISBN: 978-971-705-252-6