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Heat Capacity Evaluation For Star Champa (Distichia Muscoides)

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Abstract

The study was aimed at determining the physical-chemical properties for the Champa Estrella, located in the Puna Region, surrounding Lake Junín, where there are wetlands or oconales. The research design is experimental, where35% of the sample comes from Carhuamayo and surrounding areas (Huayre, Uco, Pariacancha, etc). 52.7% of the villagers cut it 90 x 30 x 10 cm. The pillows are piled between May and July, according to 75.4% of the population. The most commonly used champas are between 2 and 6 months. The humidity, between 14 and 16%, the combustible material between 40 and 60% of the weight. The ashes of the combustion between 24 and 46% of the weight. The calorific capacity, between 2.1 and 2.4 Kcal/g of sample; so, it is considered a very poor fuel. The flame temperature, between 750 and 780ºC. 51.9% of the rural population use it because it is economical, 26.3% because it keeps food warm and keeps the house warm, 21.8% because cooked food is more natural and richer, 33.7% consider that the smoke produced causes damage to the lungs and 13.2% believe that the exploitation damages the soil.

Keywords: star champa, environmental degradation, heat capacity.

INTRODUCTION

Distichia Muscoides is known by the locals of the Junín Region, Peru, as the Champa Estrella (star champa), which is located in the Puna Region, surrounding Lake Chinchaycocha, where there are wetlands or oconales (Mercedes & Granda 2005).

"Distichia Muscoides can form floating islands in marshy soils, clog water bodies or grow on stream banks" (Gonzales et al., 2016).

Distichia Muscoides forms large peatlands or wetland ecosystems, which allows it to accumulate organic matter with permanent flooding, this being a great carbon reserve, maintaining the water balance of ecosystems and regulating the distribution of water used by human communities (Valderrama, Buitrago & Bedoya, 2017).

One of the most important elements of the wetlands is the species Distichia Muscoides, which, without the presence of water, suffers a greater state of degradation (Bazán, 2017).

Peat is used by the local population as fuel and taken to other places as heating in the forest nurseries. Peat extraction is related to low-income families, who live far away from the population center or estancias and only have this sole resource for cooking and heating. It is related to low-income or unemployed people (Valencia, 2019).

Peat, are extracted during the dry season, using a hoe and have an approximate dimension of 70 x 35 cm with average depths ranging from 2.5 cm to 8 cm with the greatest depths corresponding to the bofedales (Valencia, 2019).

"Peat has been used as an alternative to firewood for more than two thousand years. However, during the last century its use as a fuel in power plants and as a substrate in horticulture has gained prominence" (Report, 2017).

The star champa is used by the population of the area as peat, in the use of fuel for cooking food or to shelter the environment. Excessive use generates a negative impact on the flora of the area because its natural regeneration as wetlands is slow, even worse with the average environmental conditions of the area (Maldonado, 2014).

Figure 1, Stacked star champa

Source: own elaboration.

Through the research, the value of the heat capacity of the star champa is pointed out, the utility given by the inhabitants of the area and the improvement of the use with other combustible materials.

MATERIALS AND METHODS

Thermal gravimetry equipment consisting of an analytical balance, an oven, a purge gas system to provide an inert atmosphere and the microprocessor for instrument control and data display,Digital flame temperature meter, and Calorimetric pump.

The investigation has been mixed, the first part, to inquire about the knowledge that about the star champa by the settler of the zone through a survey and then in the laboratory to determine the physical-chemical properties of the same one.The design of the investigation is experimental and the tests that were carried out in the characterization of the star champa was the determination of the humidity, ashes, calorific capacity and temperature to the flame.

The samples were collected from different places in the area, such as Ninaca, Chasquitambo, Huallay, Ticlacayan, Rancas, Junín, Carhuamayo, Paucartanbo.

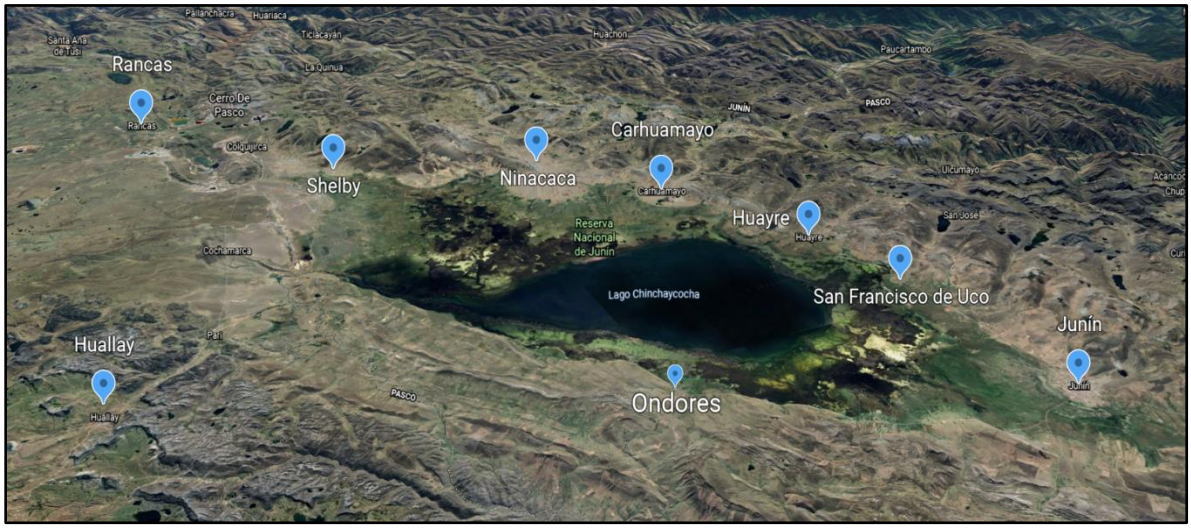

Figure 2. Sampling location

Source: own elaboration

Moisture, the water content present in a fuel, depends on the sample size, the temperature of the test and the degree of humidity of the environment. The sample is taken and placed in an oven at 105 ºC for 24 hours. The moisture content is determined by the following formula:

$$\%\mathbf{Humidity} = \left(\frac{\mathbf{a} - \mathbf{b}}{\mathbf{a}}\right) * \mathbf{100}$$

Where "a" is the weight of the wet sample and "b" is the weight of the dry sample.

Volatile material is the decomposition products of the organic substances present in the fuel, which decompose in the form of gas and vapor when the sample is heated to a certain temperature in the presence of air. Crucibles with samples are taken and their weight is determined (on an analytical balance). Then they are introduced into the furnace at different temperatures (from 100, 300, 500 and 700 ºC), keeping them in these conditions for two hours each, at the end of which the crucibles are removed, allowed to cool and then weighed on the analytical balance. The content of volatile material is determined by the following formula:

$$\%\mathbf{Material\ Volátil} = \left(\frac{\mathbf{X} - \mathbf{Y}}{\mathbf{X}}\right) * \mathbf{100}$$

Where "X" is the weight of the sample at 105°C and "Y" is the weight of the sample at 700°C.

Ash isdefined as the residue of combustion that remains at a temperature of 800ºC. This test makes it possible to determine the amount of inorganic matter in the fuel. The ash content is determined by the following formula:

$$\%\mathbf{HCeniza} = \left(\frac{\mathbf{Y} - \mathbf{B}}{\mathbf{Y}}\right) * \mathbf{100}$$

Where "Y" is the weight of the sample at 700°C and "B" is the weight of the sample at 800°C.

Heat capacity, the calorific value of the Champa Estrella, is determined as a direct measure of the heat given off by burning the fuel in the calorimetric pump with pure oxygen and at high pressures.

Flame temperature, a digital thermometer was used in the range of 200-800°C, which measures the heat emitted by a body by radiation.

To obtain information on the domestic use of star champa, which is used as fuel,a survey of ten questions has been applied to the villagers of the area, who are also the ones who have provided the samples of star champa.

RESULTS

Results of the physical-chemical analysis for Distichia Muscoides

Table 01. Results of analysis for Distichia Muscoides (Champa Estrella)

Champa Mustard Harvesting Time	Humidity (%)	Fuel Material (%)	Ash (%)	Heating capacity (%)	Flame temperature (%)
2-6 months	14-16	40-60	46-24		
1-5 years	8-10	60-75	32-15	2.1-2.4	750-780
5-10 years	6-8	75-86	19-20		

Source: own elaboration

Survey Results

1. Can you define what type of Champa you are using in your kitchen?
   79.4% of the respondents indicated that they make use of star champa, 8.8% make use of dung, firewood and 11.8% make use of sponge grass (Kuncush).

2. Can you tell the place, from where the Champa is extracted?
   35% of those surveyed said they were from Carhuamayo and surrounding areas (Huayre, Uco, Pariacancha, etc), 32% from Ninacaca, 14% from Rancas, 8% from Junín, 2% from Huallay, 2% from Ondores, 7% from other places.

3. What is the Champa harvest season in your area?
   75.4% of respondents indicate that they harvest between May and July, 16.8% harvest between April and June, 7.8% harvest in other months.

4. How big is the Champa cut: length, width, depth (cm)?

52.7% of the respondents cut the 90 x 30 x 10 size, 34.2% cut the 50 x 40 x 10 size and 13.1% cut other sizes.

5. After what time of cutting, do you use Champa in your kitchen?
   37.3% of respondents report using it at 2 months, 31.8% use it at 3 months and 30.9% use it between 4 months and 2 years.

6. How do you prepare the champa in the combustion process?
   53.3% of the respondents indicated that they first make charcoal with firewood and when it is lit, they add Champa, 30.8% make it burn with takia, dung and Champa and 15.9% light the Champa with kerosene or gasoline.

7. Can you recognize the health effects of cooking with Champa?
   39.8% of respondents said they did not know, 33.7% said the smoke it produces causes lung damage, 10.2% said it causes air pollution, 8.4% said it has no effect and 7.9% said it causes eye damage.

8. Do you know the effects that champa generates on the environment when burned?
   63.2% of those surveyed said it produced pollution, 24.7% said it had no effect and 12.1% did not know.

9. What are the benefits of cooking with Champa?
   51.9% of respondents say it is economical, 26.3% say it keeps food warm and keeps the house warm, and 21.8% say prepared food is more natural and tastier.

10. In your personal opinion, do you think that cooking with Champa is the most suitable or could the use be improved by mixing it with other fuels?
    29.8% of the respondents indicated that they improve it with firewood, dung or taki (taquia), 14.9% that it is adequate to their economy, 13.2% that it is not adequate because it generates damage to the soil and 4.9% improve it with firewood, cardboard, guano.

It is necessary to indicate that the villagers use approximately 2000 Champas as average of a year, for a family of 4 people. The taquia is the excrement of the sheep and the firewood is brought

from Oxapampa.

DISCUSSION

The champa that they use the most as fuel, are the ones that are stored between 2-6 months, because they use it more frequently in the winter months between October and March.

The combustible material is used by the inhabitants of the area, for cooking their food, which generates a better flavor and taste to the palate.

Sierra, Guerrero and Mejía. (2014) point out in their conclusions:

> The study showed that in the rural sector of Usme, cooking with firewood continues to be a traditional use by farmers, not only because of economic conditions, but also because of cultural conditions. The characterized species have similar calorific value, standing out the samples Eucalyptus, Pine, Sauco and Acacio, with values higher than 18000 kJ/kg (4.3 Kcal/g). These results explain the farmers' preference for these species and in some way also clarify the strong pressure that has been put on the forests.

The ashes that remain in the combustion, oscillates between 24 and 46%. When evaluating peloids, the ash value is between 0.6 % and 10 %, showing its organic composition. They have a high heat capacity ranging from 3800 to 3500 (J/g. K), higher than inorganic peloids (Armijo, et al., 2018).

The heat capacity for star champa is between 2.1-2.4 Kcal/g.K of sample; so it is considered to be a very poor fuel. Rubiano, Cárdenas & Ciro, 2015 in their article conclude, that for d-limonene, its specific heat is 1,914J/g. K, due to its low thermal conductivity, which is related to the low moisture content, which makes its storage stable.

Camacho A., in his article, La madera como combustible, indicates that the calorific capacity in units of Kcal/g.C for wood is 4.5, for mineral coals 3-8, charcoal 7 and coke also 7.

Peloids or thermal muds are the **mixture of mineral-medicinal water** (sea water or salt lake water) with **organic matter** (vegetable residues, amino acids, organic acids, humus) or **inorganic matter** (clays, sediments, precipitates, peat). In addition, they also contain a **biological part** which develops during the maturation process and which will depend on the origin of the composition of the mixture.

Moraima &Simbaña (2016) present in their research abstracrt, that "the coffee husk (briquette) has a calorific value in units of Kcal/g the value of 4.16 if compared with the Eucalyptus firewood of 2.17 and Hawthorn 2.24".

In their thesis, Garces & Martinez indicate that their physical chemical analysis for these three varieties of sugarcane, the following: Cenicaña, Mayaguez and Venezuela as % Moisture, have 22.4; 5.09 and 21.8 respectively. Regarding the calorific capacity in Kcal/g of 3.14, 3.87 and 2.95

The flame temperature for the Star Champa is between 750-780ºC, the flame shows a yellow-orange coloration, which indicates bad combustion and the formation of a lot of smoke; this is verified in the soot present in their pots and in their handmade stoves.

CONCLUSIONS AND RECOMMENDATIONS

Star champa, as a fuel is poor and generates little heat compared to other materials; due to poor combustion.

The compact champa pads are cut into pieces and stacked ("pircan") between May and July which is the summer time.

Champa no longer seems to be a safe source of fuel, despite its low price or direct access from the field, due to the damage it causes to the environment.

The depreciation of the environment, due to the indiscriminate use of star champa, means that it is no longer found in some places that were once common. The extraction in the oconales "leaves a desolate panorama constituted by enormous black holes that from afar give the impression of being burnt fields. Specialists have pointed out that the predation of Distichia muscoides causes irreversible damage, since this species reproduces in a period of 80-100 years" (Necochea, 1998).

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