Physicochemical Evaluation Of *Croton Wagneri* Müll Arg. Powder (Moshquera)

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Abstract:

The *Croton wagneri* Müll. Arg. commonly known as moshquera is a wild plant endemic to Ecuador. It grows on several altitudinal floors ranging from 1000 m (3280 ft) to 3012 m (9881 ft) above sea level. The objectives of this study were to characterize the powder of the dehydrated leaves of the *Croton wagneri* Müll. Arg. (moshquera), its fatty acid composition, and to investigate its physicochemical properties. The physical characteristics of the leaves showed heterogeneous green color, herbaceous odor, characteristic bitter and astringent taste. The dehydrated leaf flour of the moshquera plant had high protein 15.63 ± 0.04 g $100g^{-1}$ and fiber content 19.53 ± 1.14 g $100g^{-1}$. Oleic acid was found the highest in the fatty acid analysis and there was a significant content of mono and polyunsaturated fats. The moshquera plant may be incorporated into foods to increase their nutritional value. Further research should be done to investigate the full applications and uses of this plant.

Keywords: Nutrients, Food, Dehydrated leafs, Protein.

Introduction:

Medicinal plants have several benefits for humanity, and one of them is their medicinal contribution due to the presence of phytochemicals and antioxidants, which makes these bioactive compounds the main source of nutraceuticals (Marcía *et al.,* 2020). This information will help determine their potential uses in fields such as agronomy, agroindustry and the food industry. Some components of these plants could also be used in pharmaceutical applications. From the earliest times, many societies have utilized plants as their main source of energy and food (Hu, 2003). Each community have

grouped these plants depending on their availability and the necessities of the population (Ouborg, Piquot, & Van Groenendael, 1999). If these foods have a significant amount of nutrients there are usually classify as regulator foods. These foods should provide vitamins and minerals necessary to maintain the structural integrity and function of the organism (Rojas, Uribe, Martínez, & Niño, 2009). Nowadays, researchers are investigating new native and endemic plants such as *Croton wagneri* to evaluate their uses and applications.

Croton Wagneri, commonly known as moshquera blanca, belongs to the Euphorbiaceae family and its genus *Croton* has over 1500 species and is distributed mainly in South America, Central America and the northern part of Africa (De la Torre, Navarrete, Muriel, Macía, & Balslev, 2008). *C. Wagneri* is a small tree or bush that has multiple branches and can grow up to 4 m. Its leaves have a spade shape and are approximately 5 cm long and have a very distinctive greenish coffee color (González, Pérez, Monan, & Rodríguez, 2020). Many cultures have consumed the leaves of native's plants to nourish their population and moshquera may have the potential to be incorporated in people's foods.

In Brazil, it is easy to find juice concentrates and isolated protein cakes from the leaves of extruded cassava. These juices can reach to about 70% protein and the isolated protein to about 90%. Because of the high content of protein in these foods, they can be considered functional foods of easy transformation, distribution and consumption (Le Guerroué, Douillard, Cereda, & Chiarello, 1996). In Indonesia, the young leaves of cassava are considered a common food and their production is estimated to be about 0.5-0.7 million tonnes/year. The consumption of 400 g of cassava leaves per capita per day would provide about 45-50 g of vegetable protein (Wargiono, Richana, & Hidajat, 2011). The leaves of cassava have a high content of nutrients which include: zinc, copper, phosphorous, magnesium, potassium and iron (Howeler, 2002). They also contain beta-carotene, vitamin A, vitamin C, B1, B6, B12, pantothenic acid which prevents deterioration of the skin, and folic acid a potent antianemic vitamin (Giraldo, Velasco, & Aristizabal, 2006). Another plant originally from Southeast Asia, Moringa oleifera, commonly known as moringa have been used in foods for breads, cookies, and meat products (Oyeyinka & Oyeyinka, 2018). Moringa in meat products have functions as an antioxidant and preservative (Doménech Asensi, Durango Villadiego, & Ros Berruezo, 2017). In the country of Chile, dehydrated quinoa leaves flour have been used to parcially subsititute wheat flour in the preparation of cookies and breads (Sáez-Tonacca, Aravena-Narbona, & Díaz Ramírez, 2018).

Many native plants such as the ones previously mentioned have the potential as sources of protein, fiber, energy and overall nutrition. Their content of antioxidants would favor mechanisms to increase immunity in the

body and eliminate free radicals (Soni & Sosa, 2013). These plants can substitute and provide alternatives for individuals in many regions of the world (Sharapin, 2001). It has been documented that *Croton wagneri* Müll. Arg is a good source of flavonoid compounds, terpenes, alkaloids, and unsaturated fatty acids. It has also been reported as a cicatrizing agent, gastroprotective, anti-inflammatory, antiseptic, and hemostatic medicine (Altamirano Pérez, 2015) (Barrera, 2016) (Pino, Terán-Portelles, Hernández, Rodeiro, & Fernández, 2018). To the best of our knowledge, the fatty acid analysis and characterization of the powder of the leaves of *C. wagneri* has not been carried out. The objective of this work was to characterize the powder of the dehydrated leaves of the *Croton wagneri* Müll. Arg. (Moshquera), to investigate its nutritional composition and mineral content

Material and method:

Collection of *Croton wagneri* leaves

The moshquera plant samples from the province of Imbabura, city of Ibarra, parish of San Antonio de Ibarra, Ecuador were collected at an elevation of 2380 m above sea level (Table 1) (Figure 1). A sample of *Croton wagneri* Müll. Arg. was provided to the herbarium located in the Pontifical Catholic University of Quito with number *QCA 165692*. A physical examination and screening process of the moshquera leaves were implemented to ensure uniformity in the product for its processing.

Table 1. Taxonomical classification of the plant *Croton wagneri* Müll. Arg

Scientific classification of moshquera	
Kingdom	Plantae
Division	Mangniliophyta
Class	Magnoliopsida
Order	Euphorbiales
Family	Euphorbiaceae
Genus	Croton
Specie	*Croton wagneri* Müll. Arg.

Source: Zhofre (2012)

Processing of the materials

Fresh leaves were placed in a digital scale BS 2202S Sartorius (Göttingen, Germany) for a total weight of 0.6 kg. The leaves were then washed with water and 1% sodium hypochlorite to eliminate the microbial load. The moshquera leaves were dried in a convection oven O.R.L model SR-0110 (Buenos Aires, Argentina) with a temperature of 40 °C for 12 hours to obtain a moisture level of less than 4%. The dried leaves were grinded to obtain a powder of less than 3 mm using a knife mill grinder. This process resulted in 150 g of dried moshquera leave flour. All the powder was packaged in polyethylene bags and stored at room temperature.

Figure 1. Leaves of the moshquera plant *Croton wagneri* Müll. Arg.

The analysis for this study were done according to standards. Protein content was determined with the microkjeldahl method AOAC 981.10, crude fat with AOAC 2003.06, fiber content with INEN 522, ash content with method AOAC 923.03, moisture content with AOAC 925.05, total carbohydrate with AOAC 986.25, total calories with the CAC/GL2: 1985 method, and fatty acid analysis AOAC 966.06.

Results and discussion:

Table 2. Physical analysis of the leaves of *Croton wagneri*

Test	Response
Color	Heterogeneous green
Odor	Herbaceous
Taste	Bitter; Astringent
Texture	Membranous

Heterogeneous green color, herbaceous odor, characteristic bitter and astringent taste were found due to the presence of bitter principles secondary metabolites, and a membranous texture (Table 2). Dehydrated leaf flour of the moshquera plant allowed to verify the presence of protein 15.63 ± 0.04 g $100g^{-1}$, fiber 19.53 ±1.14 g $100g^{-1}$, ash 10.50 ±0.16 g $100g^{-1}$, fat 4.92 ± 0.11 g $100g^{-1}$, moisture 4.84 ± 0.07 g $100g^{-1}$, total carbohydrates 44.59 ± 1.28 g $100g^{-1}$, energy 285.12 ± 5.18 kcal $100g^{-1}$, fatty acids: omega 3 (1.14 ± 0.07 g $100g^{-1}$), omega 6 (0.66 ± 0.02 g $100g^{-1}$) (Table 3) (Table 4). These results coincide with that expressed by Butt and Batool (2010) and Akende *et al.*, (2010), in the protein content (19.5 g $100g^{-1}$) and fat (4.43 g $100g^{-1}$) of *Cajanus cajan*. However, the chemical quality of *C. wagneri* is lower compared to soy (Glycine max) (Navarro *et al.*, 2014) and higher than that reported by Marcía *et al.*, (2019), compared to cassava flour dehydrated.

Results showed that the moshquera leaves flour had a high protein and fiber content with 15.63 g $100g^{-1}$ and fiber content of 19.53 g $100g^{-1}$, respectively. For a dehydrated plant leaf this will be considered relatively high (Ghaly & Alkoaik, 2010). In a study that investigated the dehydrated quinoa leaves in Peru, it was found that the protein content resulted in 11.82 g $100g^{-1}$ and fiber 1.01 g $100g^{-1}$ (Rodríguez & Soriano, 2016). Also, it was found in a study in Colombia that dehydrated cassava leaves's fiber were reported to have 11.05 g $100g^{-1}$ (Buitrago, 1990). The amount of protein in the moshquera plant compared to the quinoa leaves were significantly greater.

The monounsaturaded fats were found to be 2.02 ± 0.04 g $100g^{-1}$ and polyunsaturated fats 1.52 ± 0.09 g $100g^{-1}$. Oleic acid was found to be the highest in the fatty acid analysis out of all the fatty acids. Oleic acid has been described as the main component in olive oil protecting breast cancer. According to Win (2005), oleic acid synergistically enhances cancer drug effectiveness and lowers blood levels of cholesterol and lowers the risk of heart problems. The fatty acid analysis and characterization of the leaves of *C. wagneri* are fundamental since they will help researchers from the academia and several industries to develop and evaluate new applications and uses for this plant.

Table 3. Nutritional composition of the dehydrated leaves of *Croton wagneri*

Analysis	Average ± Standard deviation
Moisture (g $100g^{-1}$)	4.84±0.07
Protein (g $100g^{-1}$)	15.63±0.04
Fat (g $100g^{-1}$)	4.92±0.11
Ash (g $100g^{-1}$)	10.50±0.16
Fiber (g $100g^{-1}$)	19.53±1.14
Carbohydrate (g $100g^{-1}$)	44.59±1.28
Energy kcal/ 100g	285.12±5.18

Table 4. Fatty acid analysis of the dehydrated leaves of *Croton wagneri* Müll Arg

Compound name	Average ± Standard deviation
Butyric acid (g $100g^{-1}$)	0.10±0.00
Caproic acid (g $100g^{-1}$)	0.10±0.00
Caprylic acid (g $100g^{-1}$)	0.10±0.00
Capric acid (g $100g^{-1}$)	0.10±0.00
Lauric acid (g $100g^{-1}$)	0.10±0.00
Myristic acid (g $100g^{-1}$)	0.13±0.02
Myristoleic acid (g $100g^{-1}$)	0.10±0.00
Pentadecanoic acid (g $100g^{-1}$)	0.10±0.00
Palmitic acid (g $100g^{-1}$)	0.35±0.01

Palmitoleic acid (g $100g^{-1}$)	0.10±0.00
Margaric acid (g $100g^{-1}$)	0.10±0.00
Heptadecenoic acid (g $100g^{-1}$)	0.10±0.00
Stearic acid (g $100g^{-1}$)	0.21±0.01
Oleic acid (g $100g^{-1}$)	1.92±0.04
Elaidic acid (g $100g^{-1}$)	0.10±0.00
Linoleic acid (g $100g^{-1}$)	0.38±0.02
alpha-Linolenic acid (g $100g^{-1}$)	0.41±0.02
Linoelaidic acid (g $100g^{-1}$)	0.10±0.00
Arachidic acid (g $100g^{-1}$)	0.10±0.00
Eicosenoic acid (g $100g^{-1}$)	0.10±0.00
Arachidonic acid (g $100g^{-1}$)	0.27±0.01
Eicosapentanoic acid (g $100g^{-1}$)	0.36±0.03
Behenic acid (g $100g^{-1}$)	0.10±0.00
Docosahexanoic acid (g $100g^{-1}$)	0.37±0.01
Tricosylic acid (g $100g^{-1}$)	0.10±0.00
Lignoceric acid (g $100g^{-1}$)	0.10±0.00
Nervonic acid (g $100g^{-1}$)	0.10±0.00
Other fatty acids (g $100g^{-1}$)	0.41±0.01
Saturated fats (g $100g^{-1}$)	0.69±0.01
Monounsaturated fats (g $100g^{-1}$)	2.02±0.04
Polyunsaturated fats (g $100g^{-1}$)	1.52±0.09
Total omega (g $100g^{-1}$)	1.14±0.07
Total omega (g $100g^{-1}$)	0.66±0.02
Total Trans fats (g $100g^{-1}$)	0.00±0.00

Conclusion:

The proximal composition of the *Croton wagneri* flour demonstrated high fiber and protein content. Oleic acid was found the highest in the fatty acid analysis and there was a significant content of omega 3, omega 6, mono and polyunsaturated fats. The moshquera plant may be incorporated into foods to increase their nutritional value. Further research should be performed to investigate the full applications and uses of this plant.

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