RESEARCHS / INVESTIGACIÓN

Compositional analysis of malanga (Xanthosoma sagittifolium), chinese potato (Colocasia esculenta) and potato (Solanum tuberosum) for the utilization in the snack's elaboration by conventional fried.

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Abstract: The objective of the present study was to compare the compositional analyze of three types of tubers, like traditional potatoes (Solanum tuberosum) and two of them that come from untraditional like Malanga (Xanthosoma saggitifolium) and papa china (Colocasia esculenta), crops that in Ecuador aren't used for the snacks making. The evaluated components in the primordial matter and finished material were: protein content, grease, ashes, humidity, fiber, and carbohydrates, all of them were evaluated by official methods of analyze. The experiment was realized three times for each prove. It was used a program SPSS version 23, applying a variance followed by a Tukey test ($p<0,05$) with the objective of determinate some meaning statistics for deviation of tubers ways of Malanga that has a significant content of protein and carbohydrates and energetic adds were higher in comparison of the traditional snacks, these results are an alternative for the consumer and the development of new products for the food industries.

Key words: Malanga, chemise potato, potato, compositional analyze, snacks.

Introduction

The actual tendencies in the agricultural are oriented towards the search crop species that contribute at low cost to the food supply, protection of the natural resources, fairness, and diminution of the poverty. The crop species with reserves roots and stems fulfills in its majority with these requirements. Within the group of reserves stems foods of agricultural importance are the genus *Xanthosomay* Colocasia of the Araceas family[1], The significance of the Araceas foods has been recognized by FAO[2], organization that has published several documents on the importance of some tubercles and their contribution to the food safety of the developing countries.

Exists brings back to consciousness generalized of which the crop by roots and tubercles contribute energy components in high amount and that the little protein that produces is of smaller quality to the one of origin animal. However, are an important energy source in the form of starch and represent, at least, 40% of the weight of the diet[3].

Within the Araceas foods the ocumo criollo, blanco o malanga (*Xanthosoma sagittifollium* L. Schott), is a plant worked perennial grass in many tropical and subtropical countries since their tubercles are an easily digestible starch source; also, they contain proteins and vitamins like niacin, thiamin, riboflavin, and vitamin[4]. For the high nutritional value of its cormos or cormelos it can be substitute for potato[5].

Colocasia esculenta, well-known in the nutritional world like Chinese potatoe, important source of vitamins and minerals is considered tubercle since it owns thiamin, riboflavin, iron, phosphorus, vitamins B6 and C, niacin, potassium, receives, manganese, stop dietetic fiber degree and starch. Also it is a proven useful food by its humid product protein content from 1.7 to 2.5%[6].

Potato (*Solanum tuberosum*, *sp. Tuberosum*) is a crop that has gained a space in the use of its tubercles like raw material in the food industry[7]. Although the potatoes have relatively few nutrients, they contain many carbohydrates, thus are an excellent energy source. Potatoe has the protein content more elevated (around 2.1% of the weight of the product in fresh) of the family of cultures by roots and tubercles, and protein of good quality, with amino acids adapted to the human needs. Also they have high vitamin C content: one medium-size potato contains almost half of the recommended daily ingestion[8]. At present, the sector of fried has undergone significant growth, especially the consumption of snacks, chips, maize tortillas, other product derivatives of vegetal origin, and the denominated foods fast meals[9,10,11].

The frying is one of the methods of more widespread and thermal essential food processing anywhere in the world[12]. It can be defined as a particular type of baking by immersion in oil or fat food to a temperature superior to the boiling point of the water[13].

In developed countries, the tendency to the rise of the consumption of snacks is turned out from the recommendation to make it decrease the caloric ingestion in the three main meals, habit that also allows controlling the appetite[14].

The limited bibliographical information about the compositional nontraditional tubercle parameters has originated a lack of advantage in the agro-industrial product elaboration.

The objective of the present investigation was to realize a compositional analysis of the raw material and the product terminated of three types of tubercles, one traditional like the potatoes and two nontraditional ones like malanga and Chinese potatoes for the elaboration of snacks.

Materials and methods

The present research was carried out in the quality and process control laboratories of the Agroindustrial Engineering career, the National University of Chimborazo (Riobamba-Ecuador).

To obtain the snacks, malanga and Chinese potato, previously obtained from the city of Santo Domingo, were used as

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raw material, taking into consideration the potato as a control sample, which was obtained from the wholesale market in the city of Riobamba. Compositional analysis was made in triplicate of the raw materials and snacks; the weight used was 100 g of edible portion.

For the process of making the snacks, raw materials were selected, washed and peeled manually, then cut into thin slices with a thickness of 1 to 2 mm. The slices were fried at 175°C for 2 minutes and finally drained with the help of an absorbent paper for the separation of the oil from the flakes.

The compositional parameters were evaluated by means of AOAC methods, humidity was used the gravimetric method by mass difference of the compound (AOAC 925.10-1990), ash was determined by dry incineration, (AOAC 923.03-2012), crude protein (conversion factor of 6.25) was performed by Kjeldahl (AOAC 2001.11-2002), fat (ethereal extract) using Soxhlet (AOAC 920.39-2005), crude fiber acid-base method, (AOAC 962.09-2005) and carbohydrates (ELN) obtained by difference between the other components C = 100- (Protein + Fat + Ash + Fiber + Moisture), all the ingredients expressed in percentages.

The statistical analyses were performed using the SPSS program version 23. The results obtained were evaluated using an analysis of variance (ANOVA) and the Tukey multiple comparison tests, to observe if there are significant differences in the means reported in each compositional parameter, was considered a confidence level (p<0,05).

Results and Discussion

Table 1 shows the compositional analysis of the three types of tubers, in which the amounts of moisture (M%), protein (PC%), crude fiber (CF%), fat (F%), ether extract (EE%), ashes (A%) and carbohydrates.

The tubers of malanga, Chinese potato, and potato presented significant differences in the moisture parameter as shown in table 1; these results are similar to those reported by Bradbury *et al.*[15], which found values in malanga 67.1% and Chinese potato 69.1%.

The content of ash and fiber of malanga and Chinese potato did not present significant differences concerning the potato, Muñoz *et al.*[16], reported content of 1.94% (ash), and 0.07% (fat) for Chinese potato.

On the other hand, the fat content of malanga and potato present significant differences in comparison with the Chinese potato. These results of ash and fat content differ from those obtained in this investigation. Collazos *et al.*[17], performed a chemical analysis of the raw material (pituca corms), finding a: 73.7% (moisture), 1% (ash), 0.5% (fat), 0.8% (fiber) and 23.2% % of total carbohydrates.

The protein content of the Chinese potato and potato have lower values for malanga. These results contrast with the costs for malanga of 6.60% and chinese potato 3.80% reported by Devendra[18].

For the carbohydrate content, it was observed that the Chinese potato and potato do not present significant differences concerning malanga. These results differ with the value of 19.31% present in other varieties of potatoes reported by Prada[19].

On the other hand, the value found in the Chinese potato is in the range of the values reported by Pajar[20] with an amount of 22.10% of carbohydrates. Devendra[18] observed 25.02% in the malanga tuber.

The values obtained in the compositional analysis of the Chinese potato, malanga, and potato in fresh state present significant differences in some parameters, the results can be affected by several factors. Barrera *et al*[21], mentions that the proximal composition of the tubers varies from place to place depending on the climate, geographic regions, cultivation variety, soils, among others.

Table 2 shows the parameters of moisture (M%), protein (PC%), crude fiber (CF%), ether extract (EE%), ash (A%), and carbohydrates present in snacks.

Lucas *et al.*[22] determined an excess of moisture in potato chips of 4.77% at a temperature of 190°C of 2.5-3.5 min. These results are related to the values obtained from the Chinese potato and potato snacks.

On the other hand, lower moisture content was observed in the malanga snack, showing significant differences for the Chinese potato and potato. Among the meals of malanga and Chinese potato do not present significant differences with respect to the fat content, but if there is a difference with the potato snacks, this corresponds to the values reported by the Profeco Laboratory in 2008[23], in which profits were found

Tubérculos											
Determinations (g)	**Malanga**				**Chinese potato**				**Potato**			
Moisture	66.060	±	0.009	a	69.987	±	0.005	b	72.644	±	0.015	c
Ashes	2.030	±	0.000	a	2.371	±	0.005	a	1.570	±	0.317	b
Protein	7.121	±	0.001	a	4.699	±	0.231	b	3.807	±	0.250	b
Fat	0.230	±	0.000	a	0.380	±	0.000	b	0.280	±	0.000	a
Fiber	2.982	±	0.002	a	2.511	±	0.000	a	1.870	±	0.000	b
Carbohydrates	24.557	±	0.377	a	22.622	±	0.448	b	21.696	±	0.300	b

Table 1. Proximal composition (base in 100g) of malanga, chinese potato and potato tubers. Results expressed as means ± standard deviation. Means in the same row with different superscripts represent the groups for which their values differ statistically (p <0,05).

Tubérculos											
Determinations (g)	**Malanga**				**Chinese potato**				**Potato**			
Moisture	1.570	±	0.016	a	3.561	±	0.203	b	4.464	±	0.609	b
Ash	1.244	±	0.029	a	3.158	±	0.074	b	4.001	±	0.646	b
Protein	6.610	±	0.141	a	4.002	±	0.041	b	2.997	±	0.024	b
Fat	30.420	±	0.199	a	31.132	±	0.113	a	33.450	±	0.323	b
Fiber	2.611	±	0.184	a	2.394	±	0.070	a	1.060	±	0.090	b
Carbohydrates	60.154	±	0.152	a	58.144	±	0.213	b	55.086	±	0.015	c

Table 2. Results of the proximal analysis (base in 100g) of the malanga, Chinese potato, and potato snacks. Results expressed as means ± standard deviation. Means in the same row with different superscripts represent the groups for which their values differ statistically (p <0.05).

means of 30.4 to 38.9g / 100g of fat in some commercial brands of chips potato consumed in our environment (Pringles, Layds, and Ruffles).

The content of fiber in the products of taro and Chinese potatoes did not show significant differences in comparison to the potato, these values are not very representative, since according to the Argentine Food Code "Código Alimentario Argentino" (CAA) a food can be declared as a source of fiber if it contains at least 3g / 100 g, and it is declared high in texture when it presents a minimum contribution of 6g / 100 g[24].

Bravo *et al.*[25], observed 0.62% crude fiber and 23.54% fat in Chinese potato chips that were made at 180 °C for 3 min with 1 mm thickness, while Carbonell *et al.*[26], reported in their study that snacks of chips, present 3.8% protein, 34% fat and 51% carbohydrates.

According to INCAP[27], simple papillin snacks contain 66.90% carbohydrates.

On the other hand, Argudo[28], presented a 71.98% carbohydrate for fried malanga and Bravo *et al.*[25], obtained 62.91% of carbs for Chinese potato chips. The results found in the three types of snacks presented significant differences, being the snack of malanga, the one that showed higher values.

Conclusions

It is concluded that the content of nutrients in the tuber of the taro has higher values in parameters such as protein, carbohydrates, and fiber, on the other hand, the snacks of taro and potato have higher content in proteins and carbohydrates compared to the traditional meal. This research provides relevant information for the development of new products in the food industry, in addition to presenting an alternative for the consumers' daily diet.

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