Characterization of promising potato clones (*Solanum tuberosum* L. subspecies *andigena*) for starch extraction

Caracterización de clones promisorios de papa (*Solanum tuberosum* L. subespecie *andigena*) para extracción de almidón

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ABSTRACT

Colombia has been overproducing potatoes with around 18% remaining unmarketable, constituting a potential alternative use in obtaining native starch for the food industry. To this end, 17 promising potato clones from the Programa de Mejoramiento Genético of Corpoica were characterized for agronomic variables, as well as physicochemical variables for the tubers. The results were analyzed with descriptive statistics, Pearson correlation and cluster analysis. Clone codified 36 was selected as having potential for the extraction of native starch, showing agronomically: a plant height of 75 cm, a green and undulating stalk, moderate deep purple and white blooming, semi-stellate-shaped corolla, green globe-shaped berries, oval tubers with a creamy white peel color and dotted with purple spots; physicochemically the tubers had: 1.090 specific gravity, 23.12% dry matter, 16.82% starch (22% amylose and 78% amylopectin), 0.122% reducing sugars, 2% protein, 0.82% ash and a pH of 5.69. The extracted starch showed a yield of 53.66% with 19.32% moisture.

Key words: agronomic variables, physicochemical characteristics, food ingredients, tubers processed.

RESUMEN

En Colombia se ha presentado sobreproducción de papa con aproximadamente 18% de remanente no comercializable, constituyéndose en una alternativa potencial para su aprovechamiento en la obtención de almidón nativo, dirigido a la industria de alimentos. Para tal fin, se caracterizaron 17 clones promisorios de papa procedentes del Programa de Mejoramiento Genético de Corpoica, a partir de las variables agronómicas de las plantas y las características fisicoquímicas de los tubérculos. Se analizaron los resultados con estadística descriptiva, correlación de Pearson y análisis clúster. Se seleccionó el clon 36 como potencial para la extracción de almidón nativo, el cual mostró agronómicamente: plantas con altura de 75 cm, tallo verde con forma de alas onduladas, floración moderada de color morado intenso y blanco, forma de corola semiestrellada, baya verde de forma globosa, tubérculo de forma ovalada con color de piel blanco-crema y con manchas salpicadas de morado; fisicoquímicamente se obtuvo tubérculos con: gravedad especifica de 1,090; materia seca 23,12%; almidón 16,82% (amilosa 22% y amilopectina 78%); azúcares reductores 0,122%; proteína 2%; cenizas 0,82 % y pH de 5,69. El almidón extraído presentó un rendimiento de 53,66% con una humedad de 19,32%.

Palabras clave: variables agronómicas, características físico-químicas, ingredientes alimentarios, tubérculos procesados.

Introduction

In Colombia for 2008, potato overproduction resulted in a high surplus, with around 18% remaining unmarketable (SIC, 2011; Vélez, 2008), causing postharvest losses for farmers. Furthermore, in 2010, the country imported 24,001 t of grain mill products and starches (DANE, 2011), which is why, this demand represents an alternative use for the mentioned surplus potatoes: for obtaining native starch, since this tuber has an approximate starch concentration of 16 to 20% (FAO, 2009).

Globally there are thousands of *Solanum tuberosum* potato varieties with large differences in size, shape, color, texture, and flavor qualities (FAO, 2009), which is why it is important to characterize them according to the potato morphological descriptors established by Huamán (2008), to obtain an adequate description of crops. Furthermore, the physicochemical properties of the tubers specify their potential uses for fresh consumption and processed products (Moreno, 2000), for which, quality *S. tuberosum* potato tubers, according to Estrada (2000), must have a high specific gravity which is correlated with the content of dry matter and starch; variables that can be estimated by means of the Hougland conversion tables (Shaw and Booth, 1980), to identify clones with the highest potential for extraction of native starch. As for reducing sugars principally glucose, fructose and sucrose in the potato, the

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concentration is low (between 0.1 to 0.7%) (Woolfe, 1987), which during processing, can react with amino acids, producing a browning reactions, bitter taste and, likewise, the nitrogen compounds are present at around 1 to 2% (Shaw and Booth, 1980), which contain protein enzymes that can cause disagreeable flavors and colors; also the potatoes are a source of trace minerals although in small quantities (Shaw and Booth, 1980), which are estimated by the ash; while the pH influences some tuber diseases, since an acid pH counteracts fungi and a neutral or alkaline pH counteracts bacteria (Ames, 1997).

Starch chemically consists of a amylose-amylopectin mixture that varies depending on the source of the origin (Munck *et al*., 1988); the extraction process seeks to break the potato cell walls and release tuber starch granules by disintegration or grinding, followed by the addition of water and filtration to separate the starch particles suspended in the liquid of those that are relatively larger such as fiber, then the water is removed, the sediment is washed to remove starch impurities and finally it is dried (FAO, 2007). Also, knowing the moisture content of the starch can determine its stability over time, typically for a native potato starch this variable is between 7.0 to 13.3% (Hoover, 2001).

However, the potato needs to incorporate new crop characteristics of resistance, resilience and yield, meaning that breeding is an effective and necessary tool for creating modern varieties with ontogenetic, physiological and morphological characteristics that control resistance genes for adverse conditions, pests and diseases, for different purposes (Bonierbale *et al*., 2001). Therefore, the Programa de Mejoramiento Genético de Papa of the Corporación Colombiana de Investigación Agropecuaria (Corpoica) has been evaluating potato clones (*Solanum tuberosum* L. subspecies *andigena*) for insect tolerance to improve agronomic traits and produce tubers with superior quality for fresh consumption and industrial processing.

Given the above, the present study aimed to evaluate the agronomic and physicochemical characteristics of 17 promising potato clones (*Solanum tuberosum* L. subspecies *andigena*) from previous research, to identify, group and select clones with a promising potential for native starch extraction.

Materials and methods

Planting and harvesting was carried out in a clayey soil with moderate fertility and a pH of 5.9 at the Centro de Investigación Tibaitatá de Corpoica located in the municipality of Mosquera, in the department of Cundinamarca, Colombia at 2,550 m a.s.l., with an average temperature of 13°C, precipitation of 750 mm year^{-1} and 73% RH; with the coordinates 4°42' N and 74°12' W. The physicochemical experimentation and starch extraction were performed in the Corpoica Laboratory of Animal Nutrition.

Materials

Plants of 17 promising potato clones (*S. tuberosum* ssp. *andigena*) were evaluated, which came from the Programa de Mejoramiento Genético de Papa of Corpoica with own codes, planted in plots of four rows, 5 x 10 m in length, separated by one meter. From the two central rows, tubers of each clone were harvested, eliminating one meter at each end of the row and randomly taking 2 kg of tubers for analysis; using a randomized complete block experimental design with three replications.

Agronomic evaluation

Initially, the number of tubers sowed per clone and the number of rows employed were recorded. During the vegetative phase, the following variables were determined for the potato clone plants, descriptors proposed by Huamán (2008): stem color and shape of the stem surface; additionally, the thickness and height of the plant stalk were quantified by direct measurement. Later, in the reproductive stage, flower color (primary and secondary) and intensity, pedicel color, calyx color and corolla shape were assessed, and also the degree of flowering, shape of the berries and primary and secondary colors were established. Afterwards, the tubers were evaluated for: primary color, secondary color and distribution of color in the peel and flesh (pulp), predominant form and eye depth. All the characteristics of the reproductive stage were assessed according to the descriptors proposed by Huamán (2008).

Physicochemical evaluation of potato clones

The tests performed were: specific gravity with the weight in air - weight in water method (Shaw and Booth, 1980) and the data adjusted with correction factors (Gould, 1999), dry matter and starch were determined from specific gravity values by the Houghland correlation tables (Shaw and Booth, 1980), humidity difference obtained by dry matter, the reducing sugars were estimated with the 3,5-dinitrosalicylic acid method (DNS) (Miller, 1959), total protein was determined using Biuret reagent (Pointe Scientific, Canton, MI) according to the official method of the Association of Official Analytical Chemists - AOAC 935.11 (AOAC, 2005), samples of protein and reducing sugars were measured in a spectrophotometer (Spectronic 601, Milton

Roy Company, Midland, Canada) at a wavelength of 540 nm, for the determination of ash: samples were carbonized in a heating plate until there was no presence of volatile vapors and then calcined in a muffle furnace (Thermolyne 48000, Termolyne Instruments, Gaithersburg, MD) with the AOAC 941.12 method (AOAC, 2005) and pH was measured directly at a temperature of 20°C with a pH meter (model 611, Orion Research, Cambridge, MA).

Native starch extraction

The starches were obtained according to the methodology of Singh and Singh (2001). The potatoes were fractionated in a food processor (PAIE, Skymsen, Brazil) with sodium metabisulfite ($Na_2S_2O_5$, Sigma Chemical Company, St. Louis, MO) to avoid browning reactions and 1 kg was taken from each of the 17 clones, ground in a blender (Oster, Milwaukee, WI) and the liquid was filtered through muslin. The filtrate created sediment and the resultant slurry was placed in an artisanal dehydrator with recirculating air. The obtained starch was pulverized in a mill (Cemotec 1090, Tecator, Höganäs, Sweden), screened with a # 100 sieve (φ = 150 μm) (Pinzuar, Bogota) (ASTM E 11/09) and stored in airtight bags (high density, resealable Zip-lock® polyethylene PE). The extraction yield was determined from original starch contained into the tubers and the starches extracted. With starch, the amylose-amylopectin content was determined with the methods of Herrera *et al*. (2003) and McGrance *et al*. (1998) and the samples were measured in a spectrophotometer (Spectronic 601, Milton Roy, Midland, Canada) at a wavelength of 600 nm; and the moisture was recorded according to method 925.10 (AOAC, 2005), placing the samples in a drying oven (ULE 400, Memmert, Germany) until constant weight. The chemical reagents used were obtained from commercial sources and were of an analytical grade.

Statistical evaluation

Results are organized in a database and processed statistically using the statistical analysis system package - SAS® version 9.1 for descriptive analysis, Pearson correlation analysis and cluster analysis based on the principal components, to identify, group, and select potato clones with a potential for starch extraction.

Results and discussion

Agronomic characterization

The 17 potato clones showed a range for plant height between 35 and 78 cm, values that are within those mentioned by Quintero *et al*. (2009) for different potato genotypes (*S. tuberosum*), a characteristic that is related to climatic conditions and genetic behavior (Quintero *et al*., 2009). In addition, the plants developed undulating, green stalks and an average stem thickness of 1.11 cm (Tab. 1).

Sparse blooming dominated the crop, the pedicel color was completely pigmented, the calyx color was slightly green and the corolla was semi-stellate-shaped. Most had a flower primary color of pale purple and white for the secondary color. There was no significant production of berries and the few that presented were green with little white dots and globose shaped (Tab. 1). All this shows that the clones had development according to phenological growth.

All data obtained for each of the studied variables showed high variation, which indicated that the averages or trends

TABLE 1. Descriptive statistics of the vegetative and reproductive stages of the 17 potato clones from Programa de Mejoramiento Genético de Papa (Corpoica).

Variables	Average or mode	Minimum	Maximum	Standards deviation	Coefficient of variation (%)
Plant height (cm)**	60.53	35	78	12.86	21.25
Stem thickness (cm)**	1.11	0.64	1.62	0.21	19.25
Stem color *	1	1	5	1.53	153.09
Stalk shape *	2	1	3	0.58	28.8
Flowering degree*	3	3	5	0.61	20.2
Pedicel color*	8	1	8	2.16	27.02
Calyx color*	5	2	7	1.3	25.98
Corolla shape*	3	2	4	0.35	11.55
Primary flower color*	7	4	8	0.95	13.53
Intensity*	2	2	4	0.7	35.15
Secondary color*	2	1	2	0.5	24.85
Intensity*	0	0	4	1.43	143.08
Berry color*	2	0	4	1.25	62.31
Berry shape*	1	0	7	1.62	162.26

* Mode in the case of qualitative variables. **Average for quantitative variables.

TABLE 2. Descriptive statistics for tubers of the 17 potato clones from Programa de Mejoramiento Genético de Papa (Corpoica).

Variables	Mode	Minimum	Maximum	Standards deviation	Coefficient of variation (%)
Primary tuber color	1	1	8	2.72	272.25
Intensity	2	1	3	0.54	27.22
Secondary tuber color	8	0	8	3.64	45.44
Distribution	4	0	6	2.13	53.3
Primary flesh color	1	1	3	0.69	68.77
Secondary flesh color	0	0	7	2.13	213.21
Distribution of secondary color	0	0	7	2.02	201.64
Tuber shape	3	1	7	1.78	59.41
Rare tuber shape	0	0	0	0	0
Tuber eyes	3	1	5	0.88	29.37

TABLE 3. Descriptive statistics of the physicochemical variables and extraction yield for the 17 potato clones from Programa de Mejoramiento Genético de Papa (Corpoica).

Variables	Average	Minimum	Maximum	Standards Deviation	Coefficient of variation (%)
Specific gravity	1.095	1.085	1.117	0.01	0.76
pH	6.28	5.69	6.55	0.22	3.56
Moisture (%)	76.18	71.94	77.90	1.58	2.07
Dry matter (%)	23.82	22.1	28.06	1.58	6.62
Starch (%)	17.49	15.86	21.51	1.5	8.57
Reducing sugars (%)	0.186	0.097	0.654	0.13	69.15
Protein (%)	2.5	0.7	4.1	0.73	29.05
Ash (%)	1.3	0.6	1.9	0.43	34.04
Amylose (%)	31.6	16.5	42.0	6.97	21.05
Amylopectin (%)	68.4	58	83.5	6.97	10.19
Starch moisture (%)	14.2	3.7	22.5	5.49	38.52
Extraction yield (%)	50.81	29.97	64.20	9.11	17.94

are not characteristic for all the studied clones, but each clone behaved differently; therefore, this information is important to describe and characterize the plant clones individually. It was also found that most of the harvested potato tubers had: a peel primary color of creamy white and an intermediate intensity, with a secondary color of purple distributed in scattered spots; a white primary color for the flesh with no dominating secondary color, oval in shape and with superficial eyes. Also, there was high variation in the data of the mentioned variables, indicating that there is high diversity in the color and shape of the tubers (Tab. 2).

Physicochemical characterization of potato clones and their starches

Tab. 3 presents the results of the physicochemical variables and the extraction yield of the 17 potato clones, which showed significant differences between the tested clones.

Tab. 4 shows the Pearson correlation matrix, where seven pairs of variables are correlated. Starch was correlated with specific gravity and dry matter, presenting the same value of 0.999, which showed that the higher the starch content, the higher the specific gravity and the dry matter content (Martínez and Ligarreto, 2005). Moisture content was correlated with specific gravity and starch, obtaining an equal correlation value of 0.999 and the dry matter variable correlated with a value of -1.000; therefore, a higher moisture content means a lower specific gravity, dry matter content and starch content (Wattiaux, 2001). Finally, there was a high ratio of about -0.919 for the amylopectin and amylose variables; therefore, higher amylose content means lower amylopectin content (Geissman, 1973). Since these variables were highly correlated, they were not included in the principal component correlation analysis (Tab. 5).

In the principal components analysis (Tab. 5), it was seen that the first four principal components accounted for 77.03% of the total variation. The first contributed 27.9%, the second 18.03%, the third 17.14% and the fourth component contributed 13.06% to the total variation, which indicated that the first four components have variables that differentiate the studied clones.

Tab. 6 shows the characteristic vectors of the first four principal components for each variable coefficient that represents the importance within each vector. In interpreting the characteristic vectors, it was observed that the variables of the first component contribute most to the

TABLE 4. Pearson correlation matrix for the studied variables and extracted starch of *S. tuberosum* ssp. *andigena* from Programa de Mejoramiento Genético de Papa (Corpoica).

	Specific gravity	Moisture (%)	Dry matter (%)	Starch (%)	Reducing sugar (%)	Protein (%)	Ash (%)	pH	Extraction yield (%)	Amylose (%)	Amylopectin (%)	Starch moisture (%)
Specific gravity	1											
Moisture (%)	-0.999	1										
Dry matter (%)	0.999	-1.000	1									
Starch (%)	0.999	-0.999	0.999	1								
Reducing sugars (%)	0.132	-0.138	0.138	0.138	1							
Protein (%)	-0.277	0.281	-0.281	-0.283	-0.559	1						
Ash (%)	-0.042	0.043	-0.043	-0.045	-0.341	0.343	1					
pH	0.387	-0.384	0.386	0.386	0.026	0.190	0.005	1				
Extraction yield (%)	0.330	-0.324	0.324	0.325	0.136	-0.096	-0.143	0.145	1			
Amylose (%)	-0.106	0.109	-0.109	-0.111	-0.200	0.447	0.223	0.253	0.067	1		
Amylopectin (%)	0.018	-0.021	0.021	0.019	0.211	-0.414	-0.195	-0.256	-0.105	-0.919	1	
Starch moisture (%)	0.179	-0.178	0.178	0.174	0.284	-0.234	0.329	-0.166	0.310	-0.115	0.190	1

TABLE 5. Eigenvalues, variability and accumulated variability for the evaluated variables of *S. tuberosum* ssp. *andigena* from Programa de Mejoramiento Genético de Papa (Corpoica).

Components	Eigenvalue (λ)	Variability (%)	Accumulated variability (%)
1	2.23	27.90	27.90
2	1.44	18.03	45.93
3	1.37	17.14	63.07
4	1.12	13.96	77.03
5	0.75	0.09	86.50
6	0.50	0.06	92.76
7	0.34	0.04	97.01
8	0.24	0.03	100.00

TABLE 6. Characteristic vectors for the first four principal components of the evaluated variables of *S. tuberosum* ssp. *andigena* from Programa de Mejoramiento Genético de Papa (Corpoica).

Variable	Principal components			
	1	2	3	4
Specific gravity	-0.226	0.598	0.06	-0.364
Reducing sugars (%)	-0.498	0.137	0.012	0.199
Protein (%)	0.587	0.014	-0.005	0.038
Ash (%)	0.324	0.001	0.611	-0.326
pH	0.131	0.704	-0.204	-0.083
Extraction yield (%)	0.040	0.223	0.156	0.806
Amylose (%)	0.425	0.264	0.029	0.234
Starch moisture (%)	-0.224	0.084	0.745	0.093

variation of reducing sugars, protein and amylose; with values of -0.498, 0.587 and 0.425 respectively. The reducing sugar concentration is a variable that must be controlled to prevent non-enzymatic browning reactions or Maillard reactions (Woolfe, 1987); protein with its low content facilitates the extraction of starch because the starch remains trapped within the matrix, (Zamora, 2003); amylose and amylopectin have different physical and chemical properties that affect the characteristics of the foods in which they are found (Bello, 2000).

The second component variables were represented by specific gravity and pH tuber values of 0.598 and 0.704 respectively. Specific gravity is important because it is influenced by the content of dry matter, of which 85% is starch (Bergonzi, 2005); while the pH in the potato tuber affects the enzymatic activity of polyphenol oxidase, responsible for starch browning (Herrera *et al*., 2003).

For the third component, the most relevant variables were ash with a value of 0.611 and starch moisture with a value of 0.745. Ash is important because it represents the mineral source of the tuber (Shaw and Booth, 1980) and moisture determines the stability of the starch during storage (FAO, 2007).

The fourth component is explained primarily by extraction yield, which is a critical factor because it determines the extent of product development and production economics (García *et al*., 2002).

With the statistical results, nine structured groups were established (Fig. 1), within which the Mahalanobis distances were less than 2.82 and were organized from least to greatest distance.

Likewise, the average results of the physicochemical variables of the evaluated clones were related and analyzed for each group (Tab. 7).

Group 1. The clones 20, 31, 35 and 50 had a higher value than expected in relation to the protein compared with the other tested clones, however extracted starches showed a high amylose content, which makes it difficult to digest foods that contain them (Pabón, 2004), so these clones have potential for industries other than food producers.

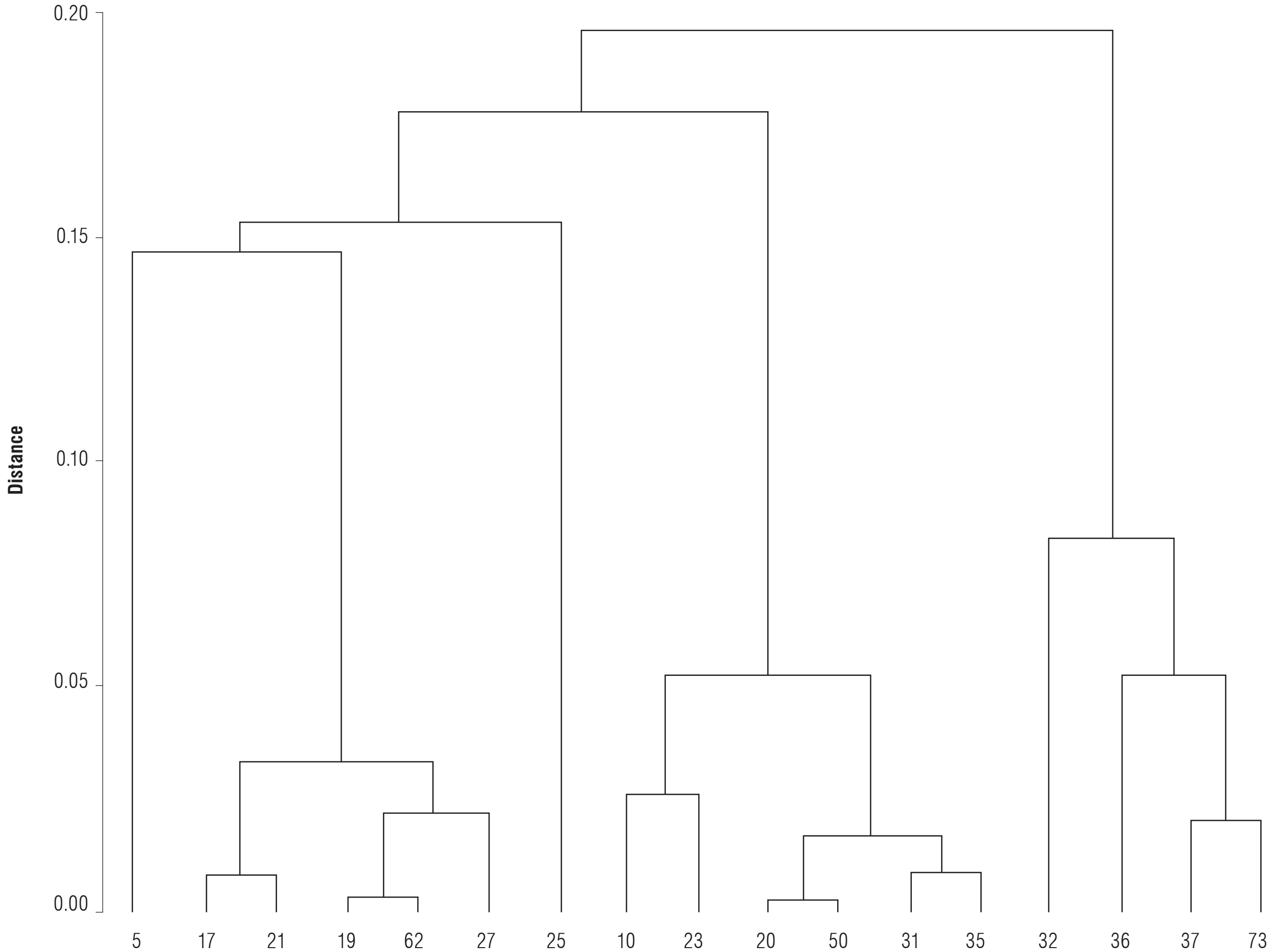

FIGURE 1. Dendrogram obtained from the evaluated variables of *S. tuberosum* ssp. *andigena* from Programa de Mejoramiento Genético de Papa (Corpoica).

TABLE 7. Variables evaluated for each group derived from the cluster analysis.

Groups	1	2	3	4	5	6	7	8	9
Clones	**20, 31, 35 and 50**	**19, 27 and 62**	**17 and 21**	**37 and 73**	**10 and 23**	**36**	**32**	**5**	**25**
Specific gravity	1.089	1.100	1.088	1.087	1.099	1.090	1.089	1.116	1.099
Moisture (%)	77.18	75.01	77.30	77.47	75.27	76.88	77.04	72.07	75.14
Dry matter (%)	22.82	24.98	22.69	22.52	24.73	23.12	22.95	27.93	24.85
Starch (%)	16.54	18.62	16.42	16.26	18.35	16.82	16.67	21.38	18.47
Reducing sugars (%)	0.169	0.155	0.173	0.136	0.132	0.122	0.226	0.128	0.650
Proteins (%)	3.25	2.49	2.61	2.33	2.30	2.00	2.42	2.42	0.75
Ash (%)	1.60	0.93	1.00	1.11	1.46	0.82	1.77	1.91	0.64
pH	6.26	6.45	6.51	6.05	6.29	5.69	6.11	6.50	6.29
Extraction yield (%)	54.95	47.05	55.90	43.30	63.81	53.66	29.96	41.05	52.01
Amylose (%)	37.04	32.60	27.25	36.00	33.00	22.00	16.50	33.00	27.00
Amylopectin (%)	62.96	67.30	72.75	64.00	67.00	78.00	83.5	67.00	73.00
Starch moisture (%)	14.19	8.27	12.30	7.80	21.23	19.32	17.59	20.20	20.71

Group 2. The clones 19, 27 and 62 had optimum values of the variables specific gravity, dry matter and moisture. These values agree with those recommended by several authors, which further confirms the potential of these clones for starch extraction. The average specific gravity should be 1.085 or more (Estrada, 2000), the dry matter

content for extraction must be at least 25% (MINAG, 2010), and the moisture content in the tuber should be a maximum of 80% (Bergonzi, 2005). However, the clones showed high values of pH and protein in relation to the other tested groups.

Group 3. The clones 17 and 21 showed the highest values for protein and pH, although the extraction yield was satisfactory there were other groups with greater potential.

Group 4. This included of clones 37 and 73 which showed high values for proteins and ash, the latter characteristic represents a good mineral content (Wattiaux, 2001). They also presented a low extraction yield, and so were not selected as potential clones.

Group 5. It was comprised of clones 10 and 23 with high values for ash, protein and pH which are not ideal for the extraction of starch. They also showed the highest values of starch extraction yield but with the highest moisture content for the starch, which favors the formation of mold and yeast, making them susceptible to fermentation reactions which increase acidity and decrease the pH of the starch (FAO, 2007). Therefore, it is recommended that this variable be controlled during storage to maintain the stability of extracted starches.

Group 6. It only contained clone 36 which had a starch content above 16%, a value recognized by the FAO (2009), in addition, this clone had the lowest recorded value for pH which is favorable because this variable reduces the enzyme activity of polyphenol oxidase (Herrera *et al*., 2003). Also, it had one of the lowest values recorded for protein, a characteristic that facilitated starch extraction and confirmed the issues raised by Zamora (2003), which represented a high extraction yield. Furthermore, this clone contained one of the highest values for amylopectin, which is more degradable than amylose, and therefore these starches displayed better digestibility (Pabón, 2004).

Group 7. It included clone 32 which had the lowest amylose content and the best value for amylopectin in relation to the other clones. This group is not acceptable because of its high protein content, high pH and lowest extraction yield.

Group 8. This was composed of clone 5 which reported the highest content of ash or minerals (Wattiaux, 2001), which justifies further studies for its use because it is not ideal for the extraction of starch since clones showing a lower ash content are preferred in order to have a greater organic matter or starch content in the tuber.

Group 9. The clone 25 had the highest reducing sugar content compared to the other evaluated clones, making it unfit for use in industrial processing because it can easily present with enzymatic browning, which can affect the quality of the products; tubers with a reducing sugar content of up to 0.5% are desired (Arboleda, 2002).

The groups of promising potato clones (*S. tuberosum* ssp *andigena*) evaluated physicochemically and agronomically showed that the primary characteristics are inherent and independent of each clone (Tabs. 1 and 2) and were not related to the secondary characteristics which determined the potential for native starch extraction. This is confirmed by the Atlantic variety cultivated in Guatemala, which has a plant height of 40-50 cm and tubers that contain 15.8% starch and 21.4% dry matter, with a specific gravity of 1.088 (González *et al*., 2009); and, due to these characteristics, it is a variety that is widely used in industries both in Central America and the United States. However the Atzimba variety, also cultivated in Guatemala, has a greater plant height, between 60-80 cm, but physicochemical characteristics with values below the range of Atlantic (10.9% starch, 16.7% dry matter and 1.066 specific gravity), so its main use has been limited to home consumption (González *et al*., 2009). This indicates the independence of agronomic and physicochemical characteristics of potato varieties.

In addition, Birchler *et al*. (1998) argued that the quantification of starches representing the carbohydrate reserves of the plant did not determine the agronomic characteristics for achieving an ideal plant, *i.e.* there is no direct relationship. They also stated that the height of a plant is satisfactory if it is found with the range established for each species according to the determining climatic conditions. All of which is evident in the ranges determined for each clone.

Conclusions

From the analysis of the groups, group 6, comprised of clone 36, was selected. This clone was agronomically characterized as having an average height of 75 cm, a green stem with few spots, an undulating shape throughout the length of the stem and a thickness of 1.4 cm, moderate blooming with 8 to 12 flowers from inflorescence, a green pedicel color, a green calyx color with abundant spots and a semi-stellate-shaped corolla. The flower presented an intense purple primary color and a white secondary color; the berries were green and globose in shape. The tuber of this clone was oval with medium depth eyes, had a creamy white primary peel color and scattered purple spots for the secondary color and white colored flesh.

Furthermore, clone 36 was physicochemically characterized with 76.88% moisture, 23.12% dry matter, 16.82% starch, 1.090 specific gravity, and low contents of reducing sugars, proteins and ash and a low pH. It had high starch extraction yield with high amylose content and low amylopectin content. Although starch moisture was high, this variable can be controlled during processing. Therefore, these results show that this clone has potential for extracting native starch.

It is important to conduct further research on native potato varieties, taking into account not only the physicochemical and agronomic characterization of the tubers but also the chemical and functional characteristics of the starch, to effectively identify the potential use in order to satisfy the needs of domestic industry.

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