



PHYSICOCHEMICAL AND SENSORY ANALYSIS OF COMMON SORREL (RUMEX ACETOSA L.)

Análise físico-química e sensorial da azedinha (Rumex acetosa L.)

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RESUMO: A Azedinha é uma hortaliça não convencional, da família Polygonaceae, naturalizada no Brasil e ainda com poucos estudos nutricionais e sensoriais. O objetivo deste trabalho foi avaliar as características físico-químicas e sensoriais da Azedinha, colhida aos 60 dias. A Azedinha foi avaliada quanto ao teor de ácido ascórbico, compostos fenólicos totais, cor instrumental: Luminosidade (L*), croma, Hue e clorofila. Para a descrição do perfil dos atributos sensoriais foram utilizados 14 avaliadores e 52 para o teste de aceitação e intenção de compra. A Azedinha apresentou 10,25 mg/100 g⁻¹ de ácido ascórbico, 290,51 mg / 100 g⁻¹ de fenólicos totais e na análise instrumental da cor, apresentou L*, croma e Hue de 49,28, 25,24 e 122,5, respectivamente. Para o índice de clorofila, observou-se 36,60 SPAD. Os atributos sensoriais descritos para Azedinha utilizando escala estruturada de 9 cm foram: coloração verde (4,6) e formato da folha irregular (4,3), aroma de casca de uva (5,1) gostos ácido e amargo (5,1 e 5,4 respectivamente), textura lisa (5,7), folha muito fina (3,3), textura macia (5,5) e folha flexíveis (6,9). Verificou-se que a Azedinha obteve notas entre 6 (gostei muito) e 7 (gostei muitíssimo) para aceitação de cor, sabor, textura e aceitação folha com global. Quanto ao aroma, 32,7% das notas foram inferiores a 4. Quanto a intenção de compra, 65,4% dos avaliadores responderam que certamente compraria a hortaliça. Embora pouco conhecida, a hortaliça foi bem aceita pelos avaliadores, demonstrando potencial de consumo.

Palavras-chave: Aceitação; Cor; Compostos fenólicos; PANC.

ABSTRACT: Common sorrel is a non-conventional vegetable of the family Polygonaceae, naturalized in Brazil and still with few nutritional and sensory studies. The aim of this work was to evaluate the physicochemical and sensory characteristics of Common sorrel, harvested at 60 days. Common sorrel was evaluated regarding the ascorbic acid content, total phenolic compounds, instrumental color: Luminosity (L*), chroma, Hue and chlorophyll. To describe the profile of the sensory attributes, 14 evaluators were used, and 52 for the acceptance test and purchase intention. Common sorrel presented 10.25 mg/100 g⁻¹ of ascorbic acid, 290.51 mg / 100 g⁻¹ of total phenolics and in the instrumental analysis of color, it presented L*, chroma and Hue of 49.28, 25.24 and 122.5, respectively. For chlorophyll index, 36.60 SPAD was observed. The sensory attributes described for Common sorrel using structured scale of 9 cm were: green coloration (4.6) and irregular leaf shape (4.3), aroma of grape skin (5.1), sour and bitter tastes (5.1 and 5.4 respectively), smooth texture (5.7), very thin leaf (3.3), soft texture (5.5) and flexible leaf (6.9). It was verified that Common sorrel obtained scores between 6 (liked very much) and 7 (loved it) for the acceptance of color, flavor, texture and global acceptance of the leaf. Regarding aroma, 32.7% of the scores were inferior to 4. Regarding purchase intention, 65.4% of the evaluators answered that they would certainly buy this vegetable. Although little known, this vegetable was well-accepted by the evaluators, demonstrating the potential for consumption.

Key words: Acceptance; Color; Phenolic compounds; PANC.

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INTRODUCTION

Common sorrel (*Rumex acetosa* L.) is a non-conventional vegetable with a typical flavor, which has been pleasing consumers and showing promise in the market. It is a plant from the family Polygonaceae, which reaches from 25 to 55 cm in height (KINUPP; LORENZI, 2014) and has little nutritional requirement from the soil (GAWEDA, 2009). The plant has received its CBD, in other words, Common Brazilian Denomination, recently, having its assets approved by the Brazilian national regulatory agency, the Brazilian Health Regulatory Agency [ANVISA] (BRASIL, 2020).

Usually found in the wild in regions of Europe, Asia and North América, in Brazil it is cultivated in regions of mild weather from Rio Grande do Sul to Minas Gerais and its leaves are consumed *in natura* in salads or cooked in soups (BRASIL, 2010), besides presenting potential for animal feed, together with other vegetables (REINÉ et al., 2020).

The non-conventional vegetables are an alternative for needy populations, since they are available and present a low market value, and they do not need the intensive care applied to the conventional vegetables. Nevertheless, the lack of information by the population regarding the nutritional value and preparation causes the reduction in their consumption (ROCHA et al., 2008).

These plants provide a more solid, safer and much wider food base than the ordinary plants that we put on the table, since they often have much higher contents of proteins, vitamins, mineral salts, fibers and carbohydrates, besides functional substances (antioxidants, carotenoids, flavonoids and anthocyanins) and other nutrients (KINUPP and BARROS, 2008; EPAMIG, 2011). For many Brazilians who live in communities that are isolated or difficult to reach, these vegetables can represent important energy and nutrient sources, contributing to local and regional food safety (SEDIYAMA et al., 2010). Therefore, there is the need to include these vegetables in the usual diet.

Common sorrel has therapeutic properties, such as anti-scorbutic, antidiarrheal, anti-inflammatory and anticancer (REDZIC, 2006), in addition to a possible help in reducing hypertension (SUN et al., 2015). It is also rich in tannins, anthraquinones, flavonoids, among many other substances (KEMPER, 1999). The roots of this plant present antioxidant activity and its mixture of polysaccharides revealed antitumor action in mice (LEE et al., 2005).

Besides the consumption of the plant *in natura*, recent studies show the potential of consumption of its extract. Santos et al. (2017) demonstrated the potential of the plant extract as source of phenolic compounds, especially anthraquinone and stilbene, when the extract was obtained by extraction by supercritical carbon dioxide.

It is worth highlighting that environmental conditions, fertilization, genetic factors, degree of maturation, plant variety, among others, greatly influence the phytochemical content in vegetables

(RAMOS et al., 2011). Studies correlating cultivation practices with the production of phytochemicals are scarce (ARBOS et al., 2010), and also scarce are works related to both the physicochemical and sensory aspects of Common sorrel.

Sensory analysis is a fundamental step to guarantee consumers demands and, for this, sensory techniques are employed which enable the knowledge of the perspectives and preferences of the consumers regarding a certain product under study.

The aim of this study was to evaluate the physicochemical characteristics and to perform the survey of the sensory attributes and acceptance of Common sorrel.

MATERIAL AND METHODS

Physicochemical analyses

The vegetable Common sorrel (*Rumex acetosa* L.) was used, harvested whole and, subsequently, sectioned at the height of the collar, 60 days after planting. After harvest, the vegetable was defoliated, selected, washed, sanitized (100 ppm of active chlorine) for 15 minutes. Whole leaves, younger and softer, were selected for the analyses.

The ascorbic acid content was determined by the method proposed by Carvalho et al. (1990), which consisted in the titration with DFI solution (2,6 dichlorophenolindophenol at 0.02 %) until light pinkish coloration, with the results expressed in mg of ascorbic acid 100 g⁻¹ of fresh sample. The total phenolic compounds (gallic acid equivalent [GAE] 100 g⁻¹ of dry sample) were determined according to the Folin-Ciocalteu spectrophotometric method with modifications (SINGLETON; ROSSI, 1965). The instrumental color was analyzed by the parameters luminosity color angle (L*), Hue and Chroma, using the colorimeter Chroma Meter CR-400 with diameter of 8mm and CIE C standard illuminant (Konica Minolta Sensing, Tokyo, Japan), in six replicates. The chlorophyll content in the leaves was analyzed using the Chlorophyll Meter SPAD-502 (Konica Minolta Sensing, Tokyo, Japan) and the results were expressed in SPAD units. The analyses were performed in triplicates and the means obtained were presented.

Sensory analysis

The sensory tests were performed in individual cabins with white light, and the evaluator received one leaf of the plant, at room temperature, on white plastic plates coded with three digits. Evaluators were selected by interest and availability.

The descriptive sensory analysis was based on the Quantitative Descriptive Analysis (STONE; SIDEL, 1983) with adaptations, corresponding only to the description of a vegetable, few samples and short time for the analyses. The 14 evaluators surveyed the attributes using the Grid Method (MOSKOWITZ, 1983) and, subsequently, the team gathered and discussed

the terms surveyed. The terms which expressed the same meaning were grouped into a single attribute and those little used were excluded. The training was performed semi-quantitatively and a list of terms with definitions and extremes was generated. The sample was evaluated using a non-structured scale of 9 cm, in triplicate.

In another test, 52 evaluators replied to questions regarding the acceptance of appearance, aroma, flavor, texture and global impression, using a seven-point mixed structured hedonic scale (MEILGAARD et al., 2007). The evaluators also assessed the samples in relation to purchase intention, using a three-point scale. The data were presented from the means obtained.

RESULTS AND DISCUSSION

Physicochemical analyses

The ascorbic acid content was of 10.25 mg / 100 g⁻¹ of fresh mass (Table 1). Other studies reporting the ascorbic acid content in Common sorrel fresh mass have not been found. Nevertheless, regarding the ascorbic acid content in dry mass, Wyk (2005) found 47 mg 100g⁻¹, and Viana et al. (2015) found 72.45 mg g⁻¹.

The content of total phenolic compounds found was equivalent to 290.51 mg GAE/100 g⁻¹ of dry mass (Table 1). Torres (2019) found, in a study with Common sorrel, 870.03 mg GAE/100g⁻¹ dry mass, an inferior value to that observed in this study.

The content of total phenolics found in Common sorrel is more expressive when compared to the values obtained in vegetables considered conventional by Arbos et al. (2010), who also used the reagent of Folin-Ciocalteu, such as in organic arugula (126.84 mg GAE/100 g⁻¹), organic lettuce (108.72 mg GAE/100 g⁻¹) and organic chicory (92.15 mg/GAE 100 g⁻¹).

According to Ceccanti et al. (2020), the leaves of Common sorrel present higher antioxidant capacity and higher content of bioactive compounds than usually observed in other traditional leafy species, which is beneficial for a long shelf-life with nutraceutical stability.

Table 1 - Results from the physicochemical analyses of the vegetable common sorrel.

Parameters evaluated	Scores average* (± standard deviation)
Ascorbic acid (mg in 100 g ⁻¹ of fresh mass)	10.25±1.42
Total phenolics (GAE 100 g ⁻¹ of dry mass)	290.51±1.82
Luminosity (L*)	49.28±5.28
Hue	122.5±1.71
Chroma	25.24±2.82
Chlorophyll (SPAD)	36.60±6.50

*means of three repetitions.

The Common sorrel presented L* of 49.28 (Table 1) and for comparison purposes, the luminosity found was inferior to that observed in lettuces: Covre et al.

(2020) found L* = 59.6, 50.7 and 57.3 in the varieties Brunela, *Green Frisly* and Vanda, respectively; Vicentini-Polette et al. (2018) observed the values 56.7, 59.1 and 57.3 in the varieties Crocanta, Crespa Crocante and Vanda, respectively; Sönmez et al. (2017), studying the variety Bitez, observed L* between 45.95, in hot months, and 61.04, in cold months. Studying different storage times of arugulas treated with UV light, and Gutierrez et al. (2017) obtained L* between 66.7 and 70.1. These results suggest that common sorrel is less bright than both lettuce and arugula.

In this study, chroma = 25.24 was observed in common sorrel. In studies with arugula, chromaticity, which represents the saturation of color, varied between 20.7 and 23.5 in the study performed by Gutierrez (2017), slightly inferior values to those observed in this study. In lettuce, Sönmez et al. (2017) observed values between 30.62 and 47.74 in hot and cold months, respectively, superior values to those observed in common sorrel.

Regarding the Hue angle, representative of tonality, the angle 122.5 was observed in Common sorrel. Gutierrez et al. (2017) observed in arugula values between 152.5 and 159.1, superior to the observed in this study. Sönmez et al. (2017) observed in lettuce values between 115.55 and 124.44 in cold and hot months, respectively – values very close to that observed in Common sorrel, being either inferior or superior.

The results of instrumental color suggest that common sorrel is brighter than lettuce and arugula, but with intermediary saturation and tonality between these vegetables, supporting the sensory perception for the green color observed (Table 2).

For the parameter total chlorophyll index, Common sorrel presented 36.6 SPAD units (Table 1). Studies related to chlorophyll content in Common sorrel have not been found. Comparing it to lettuce, Covre et al. (2020) found, for chlorophyll, values between 18.7 (variety *Green Frisly*) and 30.2 (variety *Brunela*). In kale, Alves et al. (2020) observed up to 53.89 SPAD units when the vegetable was cultivated under intercropping system with okra.

Carvalho et al. (2012), studying arugula subjected to nitrogen fertilization by fertigation in Red Latosol, observed maximum SPAD read of 49.1 in the nitrogen dose (300 mg dm⁻³), thus evidencing the high correlation between the SPAD read and nitrogen fertilization. The chlorophyll content in the leaves is influenced by several biotic and abiotic factors, being directly related to the potential of the photosynthetic activity of the plants (TAIZ; ZEIGER, 2009). Therefore, the chlorophyll index observed for Common sorrel is inside the range observed for lettuces, although inferior to that observed in the studies with kale and arugula.

Sensory analysis

Regarding the characterization of the 52 evaluators who participated in the acceptance test, 35% were male and 65% were female, and 56% of them did not know common sorrel.

The results of the sensory profile of common sorrel are presented in Table 2. The vegetable was characterized with green coloration (4.6). Color is a relevant attribute inside appearance, since it greatly characterizes the product, constituting the first criterion for its acceptance or rejection. Acceptance can be affected by the color of the vegetable, and for color acceptance, 61.5% of the evaluators declared they loved it, suggesting the intermediary green color is pleasant to the consumer (Table 3). Furthermore, the color of the plant was an attribute well accepted by the evaluators of this study.

The green color of the plants is the result of their chlorophyll content, with the appearance of yellow leaves deriving from the degradation of chlorophyll molecules (CASSETARI, 2015). In the sensory description (Table 2), we can observe that in a scale of 9 cm, the green color scored 4.6, a score very close to the center when compared to the color of crisphead lettuce (inferior end) and the color of arugula (superior end). This result supports the chlorophyll content observed, and it can be related to color acceptance, which remained in the positive part of the scale (above 5 cm).

Table 2 - Definition of the descriptive terms for common sorrel and the respective references used as extremes of the scale of 9 cm and the means of the scores obtained by the 14 evaluators.

Attributes	Description	Reference	Scores average *
Green color	Refers to the green color	Light: color of the leaf of crisphead lettuce. Dark: color of the leaf of arugula.	4.6
Irregular shape	Shape of the leaf	Slightly: shape of an arrow or spear. Very much: shape out of the standard of arrow or spear.	4.3
Aroma of grape skin	Aroma characteristic of grape skin	Light: - Strong: -	5.1
Sour taste	Typical taste of green blackberry	Light: ripe blackberry. Strong: green blackberry.	5.1
Bitter taste	Residual bitter	None: lettuce. Strong: boldo.	5.4
Soft texture	Refers to the lack of crunchiness.	Slightly: crunchy when chewing. Very much: not crunchy when chewing.	5.7
Smooth texture	Refers to the easy sliding of the fingers on the leaf.	Slightly: with wrinkles. Very much: without wrinkles.	5.5
Flexible texture	Refers to the flexibility of the leaf.	Slightly: breaks easily. Very much: foldable.	6.9
Fine texture	Refers to the thickness of the leaf.	Slightly: leaf of a succulent plant. Very much: paper sheet.	3.3

*triplicate.

Regarding the intermediary irregular leaf shape (4.3) (Table 2) (Figure 1), it was little variable, since 57.1% of the samples presented a slightly irregular

shape (values below 4.5) (Table 3), in other words, most of the leaves had the shape of an arrow or spear.

Figure 1. Illustrative photo of Common sorrel leaves 60 days after planting.



Table 3 - Results of the means and distribution of the scores referring to the variables color, flavor, aroma, texture, global acceptance and purchase intention of Common sorrel.

Scores	Score distribution (%)							Scores
	1	2	3	4	5	6	7	
Color	-	-	-	-	1.9	36.6	61.5	6.5
Flavor	-	-	1.9	1.9	17.3	38.4	40.4	6.1
Aroma	-	-	1.9	32.7	26.9	23	15.4	5.2
Texture	-	-	-	3.8	13.4	38.5	44.2	6.2
Global acceptance	-	-	-	3.8	13.4	48	34.6	6.1
Purchase intention	1.9	32.7	65.4	-	-	-	-	2.6

9-point scale (9- loved it; 8- liked very much; 7- liked moderately; 6- liked slightly; 5- did not like/did not dislike; 4- disliked slightly; 3- disliked moderately; 2- disliked very much; 1- hated it).

Scale of purchase intention test: 3 points (1- would buy; 2- maybe would buy; 3- would not buy).

Regarding aroma, the evaluators described the aroma of grape skin as intermediary (5.1), although almost the whole scale was used (1 through 9) and 57.1% of the samples presented values above 4.5, fitting in the “strong” part of the scale, suggesting its intensity.

The attributes of sour and bitter tastes presented values of 5.1 and 5.4, respectively; in other words, the leaf of common sorrel has a sourer taste, like the one of green blackberry. Such tastes can be related to the contents of ascorbic acid and total phenolic compounds, respectively.

For texture, the Common sorrel leaves were characterized as presenting intermediary smooth texture (5.7) and intermediary softness (5.5), and being very flexible (6.9). The attribute flexible was distributed throughout almost the whole scale, with 71.4% of the samples presenting means above 4.5 and being characterized as foldable (Table 3).

For the attribute fine texture (3.3) of the means, common sorrel was like a thin paper sheet.

Regarding the acceptance test, of the 52 evaluators who participated, 35% were men and 65% were women, between 18 and 55 years old, and 56% of them did not know common sorrel. The means of the

scores of the acceptability test and the distribution of the scores are presented in Table 3.

It was verified that Common sorrel obtained mean scores between 6 (liked very much) and 7 (loved it) for the variables color, flavor, texture and global acceptance.

The acceptance of the aroma obtained 32.7% of the evaluations in score 4 (did not like, did not dislike) probably because the leaf does not present a characteristic aroma if the consumer does not knead it before smelling it. The analysis of the data on purchase intention suggests considerable intention of buying this vegetable, since 65.4% of the evaluators answered they would certainly buy it, 32.7% answered they would probably buy it and 1.9% answered they certainly would not buy it.

CONCLUSIONS

1. The plant Common sorrel has potential for consumption, given its acceptance by the evaluators;
2. Although, most of the evaluators did not know the Common sorrel before this study;

3. Therefore some effort should be made in order to improve the Common sorrel disclosure among potential consumers.

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