Development of the tape pH indicator acid-basic from açai pulp extract

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ABSTRACT. *Euterpe oleracea* Mart. known as açai, it is a palm of bacaceous fruit, distributed throughout Brazil in states such as Amazonas, Pará, Maranhão, Rondônia and Tocantins. The objective of this work was to produce an acid-base indicator strip from the hydroalcoholic extract of the pulp of *Euterpe oleracea* Mart. to determine acidity by colorimetric method, also seeking to develop in a simple, fast and low cost, being an alternative way to be used in teaching Chemistry in experimental practical classes with the subject covered in Inorganic Functions in Teaching: Elementary, Middle and Higher. The methodology used was carried out in stages: (i) obtaining the acai pulp from the fruits of the açaizeiro, (ii) obtaining the extract from the pulp of *Euterpe oleracea* Mart., (iii) building a pH scale (0-14), (iv) obtaining a pH paper from the hydroalcoholic extract, (v) identification of acidic and basic substances in everyday use with both the extract and the pH indicator paper, (vi) determining the acetic acid content in commercial vinegars, and (vii) a comparison of the results obtained from % acetic acid, both with the synthetic indicator (phenolphthalein) and with the natural indicator. Through the tests with the tape and with the pulp extract of *Euterpe oleracea* Mart. satisfactory results were obtained. Thus, the pH tape and the *Euterpe oleracea* Mart. pulp extract identified the acidic, basic and neutral substances of everyday life, showing an alternative for teaching with practical experimental chemistry classes, being financially viable, and exploring an application of *Euterpe oleracea* Mart. pulp. as forest treasure for future industrial applications, such as the production of a pH indicator strip.

Keywords: *Euterpe oleracea* Mart, natural indicator, anthocyanins, pH tape

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INTRODUCTION

Açai is a type of palm tree that produces a purple bacaceous fruit (Figure 1), of the species *Euterpe oleracea* Mart. widely used as food by the population of the northern region of Brazil. Acai has become "the fruit of fashion" in the great capitals of southeastern Brazil, being widely consumed as an energy drink, mainly by the adepts of natural life who worship the physical fitness of the body (Ribeiro, 2005).

The fruit is a monocot species found in Venezuela, Colombia, Ecuador, Guyana, and in Brazil it is found in the states of Acre, Amapá, Amazonas, Pará, Rondônia and Tocantins (Cunha et al., 2011).

The pigments (anthocyanins) present in *Euterpe oleracea* Mart. are promising in the identification of acidic, basic or neutral solutions in everyday materials. Thus, they can be used in practical teaching classes, as it is a simple and low-cost production material. Anthocyanins are pigments belonging to the flavonoid class, substances responsible for the blue, purple and red coloration of various plant tissues, even in flowers and fruits as mentioned by (Silva et al., 2018).

Figure 1. Bunch of fruits from *Euterpe oleracea* Mart. found at UFPA/CUMB.

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Structurally, anthocyanin is a polycyclic structure of fifteen carbons. As seen in Figure 2, R1 (-H), R2 (-OH), R3 (-H), R4 (-OH), R5 (-OH), R6 (-OH) and R7 (-OH).

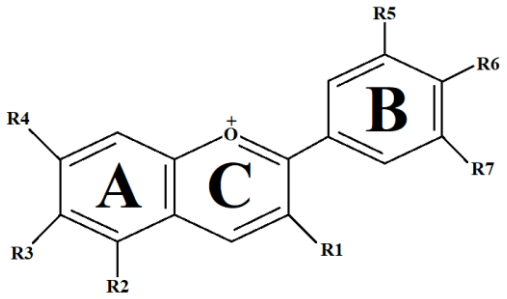

Figure 2. Chemical structure of anthocyanins by Lopes et al. (2007).

According to the study produced by Bobbio et al (2000), there are two main anthocyanins (cyanidin-3-arabinoside and cyanidin-3-arabinosyl-arabinoside) found in the extract of the back of the fruit of *E. oleracea* Mart. In this study, the quantification, via HPLC, of the total anthocyanin content was also performed, with 263 mg/100 g found in the fruit extract.

To identify an acidic or basic solution, pH indicators are used, which are organic substances that have the property of changing color with pH variation depending on the medium according to Terci & Rossi (2002).

The pH is the symbol for the physicochemical quantity, which indicates the acidity, neutrality and basicity of an aqueous solution. The term pH was introduced in 1909 by the Danish biochemist Sorensen, which literally means hydrogen potential, which measures the concentration of H^+ ions in aqueous solution (Alves, 2012). In the pH scale from 0 to 14, for pH between 0 and 6 (acidic solutions), for pH between 8 and 14 (basic solutions) and for pH 7 (neutral solutions), as shown in Figure 3.

The identification of an acidic, basic or neutral solution can be performed using a scientific instrument called pH meter, which measures the pH of the solution. Another way would be to use natural indicators (hibiscus flower, pulp of *Euterpe oleracea* Mart., Plum, carrot and cabbage), and synthetic indicators phenolphthalein, methyl orange, methyl red, violet crystal and litmus), which change color depending on the pH of each chemical substance, according to the pH of the medium in which it is inserted (Andrade, 2010).

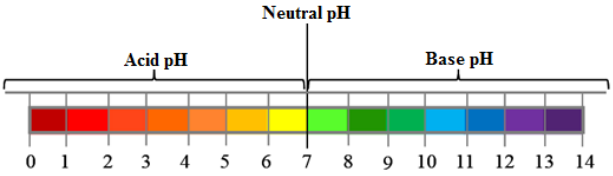

Figure 3. Acid-base pH scale.

The acid-base indicators can be universal or natural according to Terci & Rossi (2002). The universal indicators used are: bromothymol blue, methyl orange, phenolphthalein and litmus paper. However, there are some compounds present in vegetables that can be used as acid-base indicators (Ferreira et al., 2016).

The natural indicators are pigments such as anthocyanins taken from vegetables, such as red cabbage (Ferreira, 2016), beet (Martins et al. 2017), red onion (Santos, 2017), black beans (Pereira, 2017), turmeric (Silva et al. 2018), flowers such as red or pink hibiscus (Ávila, 2015), Roselle Hibiscus sabdariffa L. (Nuryanti et al. 2013), also fruits such as plum (Borges et al., 2014) and grape (Terci & Rossi, 2002), as shown in Table 1, have both a different color in acidic, basic and neutral media.

In this context, the objective of this work was the development of an acid-base indicator strip from the hydroalcoholic extract of the pulp of *Euterpe oleracea* Mart. for the identification of acidic, basic and neutral substances in everyday materials, and the acid-base indicator strip was developed in a simple, fast and low cost way, making it an alternative for teaching chemistry.

Table 1. Natural acid-base indicators reported in the literature.

Natural indicators	Species	Acidic staining	Basic staining	Neutral Staining	References
Purple plum	*Eugenia jambolana* Lam.	Pink	Green	Light pink	Borges et al. (2014)
Turmeric	*Curcuma sp.*	Yellow sun	Baby yellow	Golden	Silva et.al. (2018)
Beet	*Betas vulgaris*	Wine	Yellow	Red	Martins et al. (2017)
Purple onion	*Allium cepa*	Pink	Yellow	Brown	Santos (2017)
Black bean	*Phaseolus vulgaris*	Red	Green	Light pink	Pereira et al. (2017)
Pink hibiscos	*Hibiscus rosa - sinensis*	Red	Green	Light pink	Ávila (2015)
Purple cabbage	*Brassica oleracea*	Purple	Yellow	Red	Ferreira et al. (2016)
Roselle	*Hibiscus sabdariffa L.*	Red	Red	Red	Nuryanti et al. (2013)
Grape	*Vitis vinífera*	Pink	Yellow	Blue	Terci & Rossi (2002)

MATERIALS AND METHODS

The methodology of the present study was developed in stages: (1) obtain the pulp from *E.oleracea* Mart. from the bacaceous fruit; (2) produce the hydroalcoholic extract from the pulp of *E. oleracea* Mart; (3) produce a pH strip from the hydroalcoholic extract from the pulp of *E. oleracea* Mart .; (4) build a pH scale (0-14) using the hydroalcoholic extract from the pulp of *E. oleracea* Mart .; (5) identify the acidic, basic and neutral substances in our daily lives with both the extract and the pH indicator paper tape; (6) to determine the acetic acid content in commercial vinegars using the natural phenolphthalein indicators and the hydroalcoholic extract from the pulp of *E. oleracea* Mart.

Materials and chemical reagents

The materials and chemical reagents used during the development of the research were: hydrochloric acid (HCℓ) with a degree of purity (37% v/v), sodium hydroxide (NaOH) with a degree of purity (97% g/g), filter paper for coffee (medium size Nº 102), vinegars sold in the municipality of Breves (PA), for the sake of preserving the identity of the companies, their names were not disclosed and thus identified by the initial letters of the alphabet (A, B , C, D, E and F), commercial ethyl alcohol (CH_3CH_2OH) with a purity degree (96% v/v), aluminum foil, and materials purchased at a local supermarket in the City of Breves (PA), local pharmacy, some materials were available at the Natural Sciences Laboratory (LACIN) of the Federal University of Pará (UFPA), Campus Marajó-Breves (CUMB): distilled water (H_2O), tap water (H_2O), lemon juice, aqueous salt solution (NaCℓ), bleach (NaCℓO), neutral liquid detergent, commercial vinegar (CH_3COOH), cleans aluminum and milk of magnesia, $Mg(OH)_2$.

Preparation of pulp extract

The pulp of *E. oleracea* Mart. was obtained in a mixer in the city of Breves-Pará, as seen in Figure 4. The steps to obtain the pulp of *E. oleracea* Mart. were as follows: a) Picking and selecting the seeds of *E. oleracea* Mart. b) Thermal shock (10 seconds at 80 °C) followed by bleaching (60 seconds at 30 °C), according to the Ministry of Health recommends artisanal producers to use hygiene techniques such as thermal shock, which serves to decontaminate the fruit (acai seeds) of microbes and parasites, including the person responsible for transmitting Chagas disease, followed by bleaching (immersion in 2% v/v of sodium hypochlorite solution, NaCℓO), as well as good collection, transportation, storage and handling, in order to avoid the risk of açaí contamination. c) Washing under running tap water. d) Beat the *E. oleracea* Mart. Finally, e) Pulp from *E. oleracea* Mart. for commercialization.

The pulp of *E. oleracea* Mart. it was transported in a styrofoam under refrigeration at - 4 °C to the Natural Sciences Laboratory of the Federal University of Pará, Campus Marajó-Breves.

Figure 4. Steps to obtain *E. oleracea* Mart pulp.

Preparation and standardization of acidic and basic solutions

Preparation of the HCℓ solution (1 mol/L)

The 1 mol/L HCℓ solution was prepared from the dynamic brand HCℓ (PA) with density = 1.181 g/mL, title = 37% v/v and molar mass = 36.46 g/mol, which consists of measuring 82.91 mL of HCℓ was used with the aid of a graduated pipette and diluted to 1L in distilled water.

From the solution of HCℓ (1 mol/L) with pH = 0, in which it was measured in a meter pH of the Meter Model Brand (PHS-3B), the solutions were prepared with successive dilutions with the addition of distilled water until the pH was 1, 2, 3, 4, 5 and 6 (Baccan et al., 2001).

Preparation of the NaOH solution (1 mol/L)

The basic solutions with pH 8, 9, 10, 11, 12, 13 and 14 were prepared from a 1 mol/L NaOH solution. The NaOH solution (1 mol/L) was prepared by weighing 40 g of NaOH and diluted in 1 L of distilled water previously boiled and cooled, with the objective of removing the carbon dioxide (CO_2) remaining from the distilled water (Baccan et al., 2001).

Standardization of the NaOH solution (0.1 mol/L)

Three Erlenmeyer flasks were added 20 mL of potassium biftalate, for each flask, and then two drops of phenolphthalein were added as an acid-base indicator, and in the other flasks ten drops of the hydroalcoholic extract of the açaí pulp were added. Then, it was titrated with 0.1 mol/L NaOH solution, and the NaOH concentration was calculated, which is equal to 0.098 mol/L for phenolphthalein, and 0.092 mol/L for the hydroalcoholic extract of the pulp from *E. oleracea* Mart (Baccan et al., 2001).

Preparation of the hydroalcoholic extract of the pulp of *E. oleracea* Mart

Were used 100 g of *E. oleracea* Mart pulp were used and 100 mL of 96% v/v commercial ethyl alcohol from the Santa Cruz brand were added. Soon after, it was filtered on coffee filter paper (medium size N ° 102) to obtain the hydroalcoholic extract (Ramos et al. 2006). According to Figure 5, the extract was stored in a 100 mL dropper bottle.

Figure 5. Hydroalcoholic extract from the pulp of *Euterpe oleracea* Mart.

Tests with the pulp extract of *E. oleracea* Mart.

For the tests with the hydroalcoholic extract of the pulp of *E. oleracea* Mart. were divided into stages: in the first stage 14 test tubes were properly identified with pH ranging from 0 to 14, and each test tube was added 5 mL of each pH solution. Soon after, 3 drops of pulp extract from *E. oleracea* Mart were added and its color was observed and noted, (ii) in the second step, 5 mL of the products were added (from the daily routine separately in each test tube) , distilled water (H_2O), tap water (H_2O), lemon juice, aqueous solution of table salt (NaCℓ), bleach, neutral detergent soap, commercial vinegar (CH_3COOH), clean aluminum and milk of magnesia, and in Then 10 drops of the hydroalcoholic extract of the açaí pulp were added and the color was observed in each test tube separately and the results were recorded.

Preparation and tests with pH tape from hydroalcoholic extract (*E. oleracea* Mart.)

Figure 6 shows the steps for preparing the pH strip with the hydroalcoholic extract of *E. oleracea* Mart.In the first step according to Figure (a), the filter paper for coffee (medium size Nº 102) was placed, cut into cubes of size 5 cm wide and 5 cm long in a petri dish.In the second step, as seen in Figure 6 (d), the paper was soaked with the hydroalcoholic extract of *Euterpe oleracea* Mart. until it covered it all.In the third step shown in Figure 6 (d), it corresponded to the preparation of the pH paper, left for 2 minutes, with the objective that the filter paper absorbed a large part of the hydroalcoholic extract.In the fourth step, the filter paper was removed and placed in the oven (Marca De Leo) for drying for 1 minute at 120 °C.In the fifth step, shown in Figure 6 (e) (preparation of the pH tape), the filter paper was cut into smaller pieces of tape, 1 cm wide by 5 cm high.Finally, the products for daily use as described in item 2.5 were tested with the pH tape, and the color of the tested solutions was verified, immediately after the application of three drops of the daily solutions of each material on the tape of pH.

Determinations of acetic acid content in commercial vinegars

The determinations of the acetic acid content in commercial vinegars were carried out using the neutralization titration using the indicators (phenolphthalein and hydroalcoholic extract from *Euterpe oleracea* Mart.).

The methodology used consisted of adding 10 mL of commercial vinegar from 6 different brands separately in a 100 mL volumetric flask, and the measurement was carried out until the meniscus mark and its complete homogenization.

Then, 10 mL of the diluted commercial vinegar solution was transferred to three Erlenmeyers with a capacity of 125 mL. Then, two drops of phenolphthalein indicator were added and then the procedure was repeated in another three flasks containing the dilution of each brand of commercial vinegar. Then adding 10 drops of the hydroalcoholic extract of *E. oleracea* Mart., And titrating with the standard solution of 0.1 mol/L of NaOH, according to the methodology described in the item of standardization of the NaOH solution (0.1 mol/L), with a color change from colorless to pink using phenolphthalein as an acid-base indicator, and even a color change from red to green with the hydroalcoholic extract of *E. oleracea* Mart.

The color change was observed and the volume of NaOH spent in the neutralization titration was noted. Finally, the % w/v of CH_3COOH in each commercial vinegar was calculated, and the % g/g of CH_3COOH is transformed using the density (g/mL) for each brand of

commercial vinegar, the density being measured using a pycnometer with a capacity of 5 mL of the commercial vinegar sample.

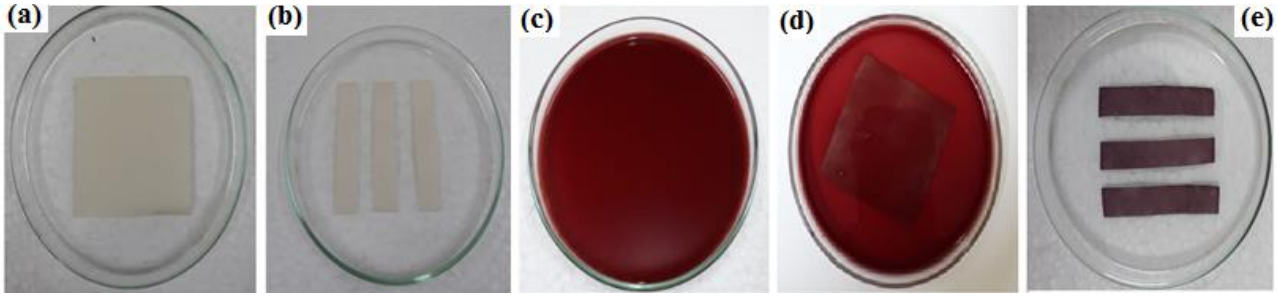

Figure 6. Preparation of the pH tape, (a) coffee filter paper (medium size N ° 102, 5 cm wide and 5 cm long, (b) the 1 cm wide and 5 cm paper tape cm long, (c) hydroalcoholic extract of the fruit pulp, and (e) pH paper tape (1 cm wide by 5 cm high).

RESULTS AND DISCUSSION

Range of pH solutions (0 a 14)

It was observed that in Figure 7, 5 mL of pH 0 to 14 solutions were placed in each test tube separately, immediately afterwards 9 drops of the hydroalcoholic extract of *E. oleracea* Mart were added.

It was found that the coloring of the color scale (pH 0 to 14) has distinct colorations, this is due to the character presented: acid (pH <7), neutral (pH = 7) and basic (pH>7). The colors found: pH 0 to pH 2 (intense red), pH 3 to pH 9 (pale red), pH 10 to 12 (dark green) and pH 13 to pH 14 (yellowish green).

According to Terci & Rossi (2001), solutions from pH 0 (acid) to pH 14 (basic) present different pH in the presence of certain extracts of vegetable pigments, since they assume different colors that can be easily identified by visual observation, which are defined as pH scales depending on the color of the resulting solution.

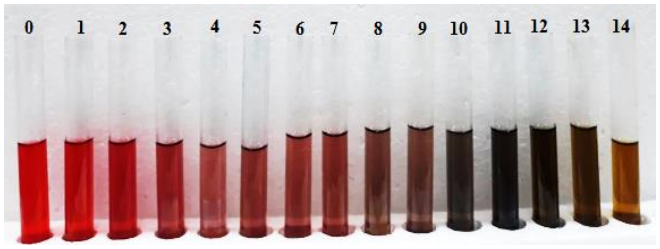

Figure 7. Scale of pH solutions from 0 to 14 using the hydroalcoholic extract of *E. oleracea* Mart pulp.

pH tape scale (0 a 14)

In Figure 8, you can see the result of a pH strip varying the pH from 0 to 14, with different colors being obtained: pH 0 to pH 2 (red color), pH 12 (blue color), pH 13 (green color) and pH 14 (yellow color).

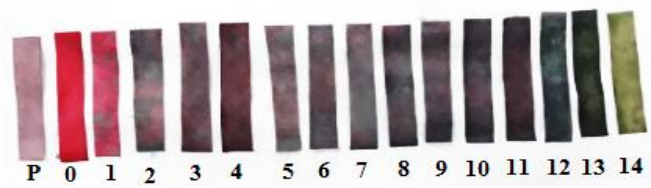

Figure 8. Scale of pH solutions from 0 to 14 using the pH strip obtained from the hydroalcoholic extract of the pulp of *E. oleracea* Mart.

Everyday products with extract test

Figure 9 presents the results of tests with products of daily use using the hydroalcoholic extract of the pulp of *E. oleracea* Mart., which presented the following colors: (1) tap water: red color, (2) distilled water: red color , (3) lemon juice: red color, (4) orange juice: red color, (5) aqueous table salt solution: red color, (6) bleach: yellow color, (7) neutral detergent soap: red color, (8) commercial vinegar: red color, (9) clean aluminum: red color, (10) milk of magnesia: light green color and (11) ammonia: dark green.

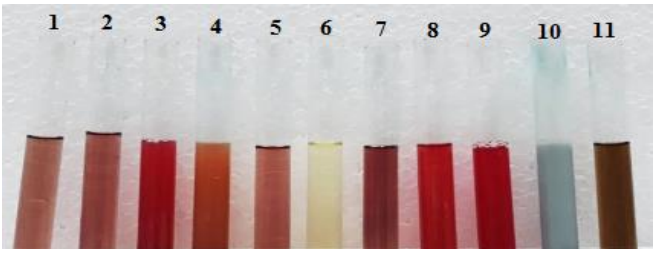

Figure 9. Results of the acidity test with everyday products.

Products for everyday use with pH tape testing

Figure 10 shows the colorations: (1) The tape with the hydroalcoholic extract, (2) tap water has been showing a grayish color, that is, its pH is neutral (3) distilled water is also a neutral solution, (4) lemon juice, a red color, showing to be an acid solution present in our daily life (5) orange juice acid solution, where it presents a wine color (6) table salt (7) bleach a yellow color, a base that is also present in our daily lives, (8)

neutral detergent, (9) vinegar, (10) clean aluminum has a red tint proving to be an acid solution, (11) magnesium milk a greenish color, that is, a base (12) ammonia a base, with its green color.

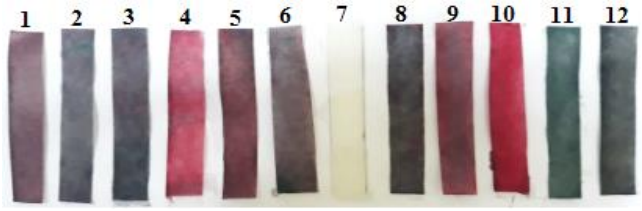

Figure 10. pH tape obtained from *Euterpe oleracea* Mart extract. for product testing.

Tests of commercial vinegars with the extract of *Euterpe oleracea* Mart. and with the pH tape

The samples of commercial vinegars, had their pH measured through a pH meter, which confirmed the results obtained through the pH Tape, that the vinegars have an acid character.The results obtained and observed are shown in Table 2, which correspond to: mark A (pH = 2.41), mark B (pH = 2.55), mark C (pH = 2.49), mark D (pH = 2.40), E mark (pH = 2.57) and F mark (pH = 2.50).

The pH of the medium has an effect on the chemical form, color and stability of the anthocyanins, as can be seen (Figure 11) in the different structures assumed by the anthocyanins in the form of the red flavylic cation (AH^+) predominated at a pH below 3.

According to Albarici et al. (2008), observed in Figure 11, the pH increases when the cation loses a proton undergoes hydration, forming a colorless pseudobase or carbinol (Figure 11 B) at pH less than 6, the carbinol is transformed by tautomerism into a chalcone (Figure 11 C) pale yellow at pH between 12 and 13. Increasing the pH above 6, the flavilium cation loses protons, first forming the pale purple quinoid base (Figure 11 A) which then at pHs above 9 loses another proton forming a dark blue ionized base. At pH above 9, anthocyanins occur mainly in ionized forms andchalcone.

As can be seen in Figure 12 (a), for all commercial vinegar samples, which were tested with the pH tape produced from the pulp extract of *E. oleracea* Mart., In which the color obtained was red, which indicates that commercial vinegars (A, B, C, D, E and F) have an acid character (pH < 7).

At the same time, 5 ml of each commercial vinegar were placed in test tubes and then 10 drops of the *E. oleracea* Mart.pulp extract were added. The samples showed results observed in red color, which confirms the results obtained by the pH tape. Since with the solution of each vinegar separately and with the drops of açaí extract, the color of the color was clear (red), as can be seen in Figure 12 (b).

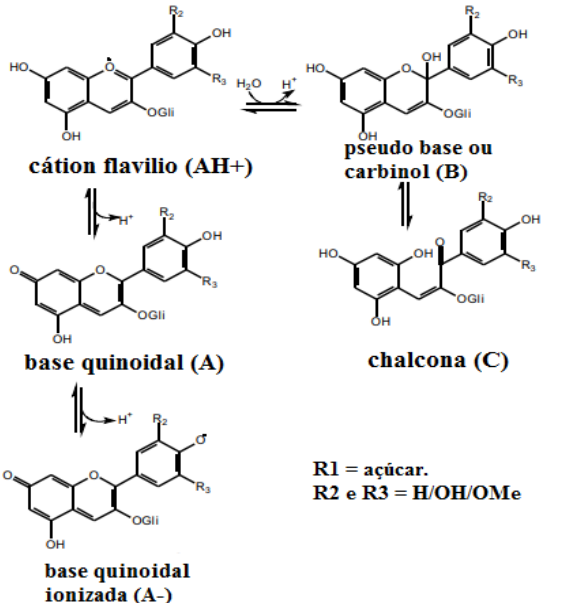

Figure 11. Transitions of anthocyanin structures as a function of pH.

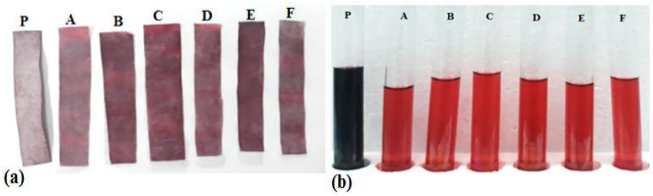

Figure 12. Tests of commercial vinegars with pH tape (a) and pulp extract from *E. oleracea* Mart. (b).

Determination of % acetic acid in commercial vinegars

The volatile acidity corresponds to the content of acetic acid present in commercial vinegars, because it occurs from the oxidation of wine alcohol in the acetification process (Takemoto, 2000). Consumer vinegar should contain between 4% g/g and 6% g/g acetic acid. Brazilian legislation establishes the minimum content of acetic acid for vinegar at 4% g/g (Anav, 2010).

The samples of commercial vinegars (percentage of acetic acid) were determined through the neutralization titration, for all samples were performed in triplicate with the average of the triplicates and with their respective standard deviation (%).

The neutralization titration consists of the acetic acid present in commercial vinegar (weak acid) reacts with sodium hydroxide (strong base), in the presentation of the phenolphthalein indicator and the natural indicator (*E. oleracea* Mart. pulp extract) separately.

It is observed that acetic acid reacts first with sodium hydroxide to produce sodium acetate and water, according to the theory of Arrhenius and shown in Equation 1:

$$CH_3COOH_{(aq)} + phenolphthalein + NaOH_{(aq)} \rightarrow NaCH_3COO_{(aq)} + H_2O_{(l)}$$ (Eq. 1)

Once all CH_3COOH has been consumed, excess NaOH reacts with the phenolphthalein indicator, according to Equation 2:

$$NaOH + In \rightarrow NaIn + OH^-$$ (Eq. 2)

Acetic acid (CH_3COOH), in reaction with phenolphthalein, produces:

$$CH_3COOH + In^- \rightarrow CH_3In + COOH^-$$ (Eq. 3)

Depending on the density values found for each brand of commercial vinegar, they are within the parameters established by the legislation, as observed in Table 2.

According to the pH values found for each brand of commercial vinegar it is within the parameters established by the legislation, as shown in Table 2. For the values found of percentage of acetic acid found in each commercial vinegar, what is outside Brazilian legislation when verified with phenolphthalein was the vinegar sample of the brand F.

However, with the extract from *E. oleracea* Mart. when tested, two vinegars were found, brand A (3.82 ± 0.07) and brand F (2.29 ± 0.06) are outside the specifications of Brazilian legislation, which is a minimum of 4%w/w to 7%w/w maximum acetic acid present in commercial vinegar (Rizzon, 2006).

Table 2. Percentage of acetic acid, pH and density of commercial acetic acids.

Acid-base indicator	Vinegar brand	Specific mass (g/mL)	pH	CH_3COOH (% g/g)
Phenolphthalein	A	1.01 ± 0.01	2.41	4.42 ± 0.06
	B	1.00 ± 0.00	2.55	4.20 ± 0.07
	C	1.01 ± 0.00	2.49	4.90 ± 0.16
	D	1.00 ± 0.00	2.40	4.47 ± 0.03
	E	1.01 ± 0.00	2.57	4.57 ± 0.03
	F	1.00 ± 0.01	2.50	2.21 ± 0.07
Hydroalcoholic extract of the pulp of *E. oleracea* Mart.	A	1.01 ± 0.01	2.41	3.82 ± 0.07
	B	1.00 ± 0.00	2.55	4.30 ± 0.03
	C	1.01 ± 0.00	2.49	4.70 ± 0.09
	D	1.00 ± 0.00	2.40	4.19 ± 0.12
	E	1.01 ± 0.00	2.57	4.55 ± 0.10
	I	1.00 ± 0.01	2.50	2.29 ± 0.06

(n = number of measurements, in triplicate with ± standard deviation).

According to Baccan et al. (2001), the acid-base titration or neutralization technique consists of a quantitative analysis method that serves to determine the concentration of an unknown acid or base, neutralizing it with a standard solution of known concentration, acid (acidimetry) or (alkalimetry) in the presence of acid-base indicators, in this case it was phenolphthalein.

Figure 13 presents the results obtained in the acid-base titration, using phenolphthalein as an acid-base indicator, at the beginning of the titration (colorless color), at the end of the titration (pink color), for the use of hydroalcoholic extract as indicator, at the beginning of the titration (red color) and at the end of the titration (green color).

Table 3 describes the products of daily use with their pH values measured through a pH meter, their colorings with the pulp extract of *E. oleracea* Mart. and pH tape.

It was found that the minimum values were 3.75 (orange juice) and at the same time both colors in acid medium were red, which characterizes the product as an acid character. For the bleach, a basic character was presented, due to its high pH (12.87), coloration in basic medium (yellow) for the pulp extract of *E. oleracea* Mart. how much pH tape. Finally, the product (neutral detergent) had its pH (7.42), brown in neutral pH.

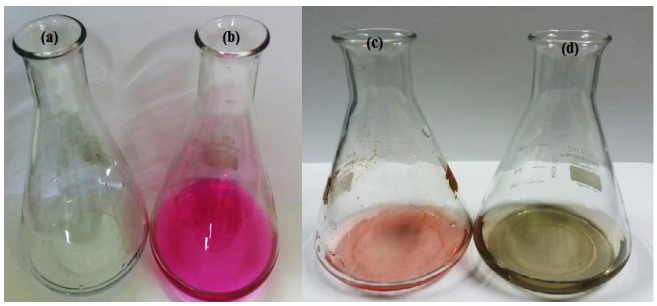

Figure 13. Acid-base indicators: phenolphthalein (a) and (b), and hydroalcoholic extract from *E. oleracea* Mart. (c) and (d).

Table 3. Summary of the results obtained for the tested products for everyday use.

Products	pH	*E. oleracea* Mart. Coloring	pH Tape Coloring	Character
Tap water	5.47	Red	red	acid
Distilled water	6.98	Red	red	acid
Limon juice	1.53	Red	red	acid
orange juice	3.75	Red	red	acid
Cooking salt	7.05	Red	red	acid
Sanitary water	12.87	Yellow	yellow	basic
neutral detergent	7.42	Brown	brown	neutral
Vinegar	2.40	Red	red	acid
Cleans aluminum	3.56	Red	red	acid
Milk of magnesia	10.33	Green	green	basic
Ammonia	12.40	Yellow	yellow	basic

CONCLUSION

The results obtained for the hydroalcoholic extract from the pulp of *Euterpe oleracea* Mart. were satisfactory for its use as a natural acid-base indicator, mainly for the construction of the pH color scale (0 to 14), also for the identification of everyday products.

The colorations obtained, both in the pulp extract of *Euterpe oleracea* Mart. as for the pH strip, they were clear and perceptible to the human eye (qualitative method) and to the quantitative method (% acetic acid in commercial vinegars).

The pulp of *Euterpe oleracea* Mart. deserves prominence in the production of the State of Pará, mainly for the city of Breves, as there are many açaí producers in which they live economically from the production of açaí to obtain the pulp.

The hydroalcoholic extract of the açaí pulp serves as an acid-base indicator for the determination of acetic acid in commercial vinegars, also the pH tape (identification of acidic and basic solutions in commercial products), which are promising, also presenting a viable alternative and economical for use

in chemistry experiments to replace the commercial acid-base indicator (phenolphthalein), with the materials being able to be produced in various chemistry laboratories worldwide and by industries in the materials area.

Thus, a future suggestion would be that the final product (pH indicator tape) could have a patent registration, as it is an alternative technological product to teaching chemistry and of low cost.

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