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Study Of The Ph Of The Wood Of Five Forest Species From The Subhumid Forest Of Huarango, San Ignacio Using Two Extractors

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Abstract
The objective of the study was to evaluate the quadratic correlation coefficients obtained from the value of the hydrogen ion potential (pH) of particulate samples (sawdust) of the forest species Aspidosperma polyneuron Müll.Arg (acerillo), Cordia iguaguana Melch. former I.M. Johnst (iguaguana), Licaria triandra (Sw.) Kosterm (latero), Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn (michino) and Nectandra reticulata (Ruiz & Pav.) Mez (roble), using calcium chloride dihydrate ($CaCl_2.2H2O$) 0,01M and distilled water as extractors, varying their volumes from 50ml, 75 ml, 100 ml, 125 ml and 150 ml, for a sawdust weight of 10 g. The results showed that the lowest average slope was 0.0084 for an average correlation coefficient (R^2) of 0,9334 of the pH in the filtrate with 0.01 M $CaCl_2.2H2O$, demonstrating less dependence between the sawdust/extractor ratio. It was also evident that for the extractant $CaCl_2.2H2O$ the pH values in the filtrate of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. former I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez, range from 6,97 to 7,00, 7.15 to 7,20, 6,76 to 6,79, 7,04 to 7,07 and 7,08 to 7,11 respectively, concluding that the pH value of the sawdust samples of these species should be carried out in 0,01M $CaCl_2.2H2O$ in volumes ranging from 75 ml to 125 ml.
Keywords: *pH, sawdust, suspension, filtrate*

INTRODUCTION

The pH value informs the level of acidity or alkalinity of a substance, with respect to the quantification of the concentration of hydrogen ions [H+] or oxidyl ions [OH^-]. Its measurement in wood helps to know the influence of other materials that are in contact with it, in the setting of wood, in thermal processes for the manufacture of conglomerates, gluing processes and others related to the wood industry.

Albin (1975) obtained pH values of 14 renoval species from the province of Valdivia in Chile, the samples were sawdust from two heights (DAP and cup) and the extractive media distilled water and potassium chloride (KCl) 0.1N. The ratio used was 50 g of sawdust in 50 ml of extractant. The results showed that the pH from the cup is less acidic than that from the breast height and the pH treated with distilled water is higher than those measured in KCl 0.1. Bonilla (2006) points out that the acidity (pH) of wood influences its own natural durability; that is, in the greater or lesser resistance to attack by xylophagous fungi. In addition, it influences the hardening of the glue used in wood joints, in the same way it generates corrosion of metal elements, when the wood contains a humidity greater than 18%. (p. 16).

Aliaga (2007) determined the pH in Miconia barbeyana Cogniaux (paliperro) obtaining values that varied between 3.84 and 4.133 and Sandoval (2022) measured the pH in Myrsine pellucida (Ruiz & Pav.) Spreng (red pencil) obtained values between 4.6 and 4.84; both authors point out the following

methodology, for the determination of pH, weigh 5 g of sawdust sifted inside a balloon whose capacity is 100 ml, 50 ml of distilled water is added and stirred until the mixture is homogenized, an extraction is carried out in a soxhlet equipment for 20 minutes and cooled, the extract is transferred to a 100 ml fiola and measured with distilled water, the extract is measured using a pH meter. Therefore, the ratio of the suspension was 5 g in 100 ml of water, and the pH measurement was performed under those conditions. Poblete (2004) determined the pH value in native Chilean species, myrtle, coigüe, cinnamon and tepa, the pH values obtained were 3.9, 4.7, 6.1 and 7.2 respectively, the pH was determined in the extracts in water, for this they took 10 g of bark and mixed it with 150 ml of distilled water, stirring for 24 hours measuring the pH by means of a pH-meter in the extracts. Coello (2006) and Santiago (2013) were based on the method of Sandermann and Rothkamm (1959); they point out that 2 g of unextracted wood flour should be weighed, placed in a beaker with 20 ml of distilled water, the initial pH reading was recorded with a HANNA potentiometer and it was taken again after 5 minutes. at 4 hours, 24 hours and 48 hours after the measurement begins. Arias (2021) studied the pH of the species Brownea hetrhae Harms, Croton lechleri Müll. Arg., Ladenbergia macrocarpa (Vhal) Klotzsch, Theobroma subincanum Mart. and Virola reidii Little obtaining values of 6.70, 6.26, 5.34, 6.45 and 5.39 respectively, points out that, for the measurement of the pH, the sawdust samples of the species were placed in hermetically sealed bags, for their conservation, they were then placed in a refrigerator, for less than 24 hours, then they proceeded according to the measurement of pH in soils, the ratio was 20 g of sawdust in 50 ml of distilled water, it was stirred for an hour, and the measurement was made, the weight-extractant ratios were variable in relation to the desired consistency. Guanotuña (2021) points out that the sample was sawdust, which was sifted, 20 grams of sample were weighed and diluted in 77, 110, 80, 160 and 100 ml of distilled water, for the species Clusia multiflora (pH 5.24), Erythrina edulis (pH 6.94), Myrcia fallax (pH 5.48), Nectandra membrnacea (pH 5.82) Ruagea pubescens (6,32) respectively, the mixture was stirred every 10 minutes and the retention of the sample in the extract was one hour.

As evidenced there is no consensus on the methodology of pH measurement in sawdust samples, therefore, the research problem poses the following question: What is the extractor and what volume is convenient to use between CaCl $2.2H_{2O}$ 0.01 M and distilled water, to obtain pH measurements independent of the sawdust/extractor ratio in forest species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez?

The general objective was to evaluate the slopes and the quadratic correlation coefficient, obtained from the value of the hydrogen ion potential (pH) of particulate samples (sawdust) with size less than 2 mm of the species were Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez, extracted in 0.01M calcium chloride and distilled water, varying the volumes of the extractors (50ml, 75 ml, 100 ml, 125 ml and 150 ml) and keeping the weight of the particulate matter constant (10 g). The specific objectives were: -To determine the pH value of sawdust samples from the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mix in the filtering and suspension of the $CaCl_{extractor}$ 2.2H2O 0.01M-Determine the pH value of the woods from the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mix in the filtering and suspension of the distilled water extractor. -To determine the dependence of the volume of the extractors in CaCl 2.2H2O 0.01 M and Water extractors on the pH value of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez.

MATERIALS AND METHODS

The origin of the samples corresponding to the forest species were located in the sub-humid forest of the district of Huarango, province of Jaén region Cajamarca, which were transferred to the Dendrology Laboratory for identification. The preparation of the samples was carried out in the Laboratory of

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Anatomy and Technology of Wood, following the TAPPI standards (Technical Association of the Pulp and Paper Industry, 1978), the material was particulated, until it passed the mesh of 200 microns, less than 2 mm, the samples were dried in a Memert brand oven at 80 °C for 24 hours, then they were stored to make the respective measurements. A 2.2H2O 0.01 M CaCl solution was prepared. 10 grams of sawdust sample of each species were weighed on an AND Model HR 200 analytical balance and measurements were made using the HANNA model EDGE pH meter in the 2.2H2O 0.01M and distilled H2O extractant medium with volumes of 50 ml, 75 ml, 100 ml 125ml and 150 ml. The pH measurements were made after 24 hours, for this the glass electrode is introduced directly into the container containing the sawdust-extract suspension, the potential is expected to balance for approximately 10 minutes and then the reading is taken (pH in the suspension). The suspension is filtered through a porous medium and proceeds in the same way as in the suspension (pH in the filtrate). 3 measurements were made for 5 volumes tested in filtration and suspension, for five species and 2 extractors, totaling 300 measurements, the results show the averages obtained.

RESULTS AND DISCUSSION

Determination of the dependence of the volume of the extractor CaCl2.2H2O 0.01 M on the pH values of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez.

Figure 1 pH of the woods Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez in the filtrate using CaCl 2.2H2O.

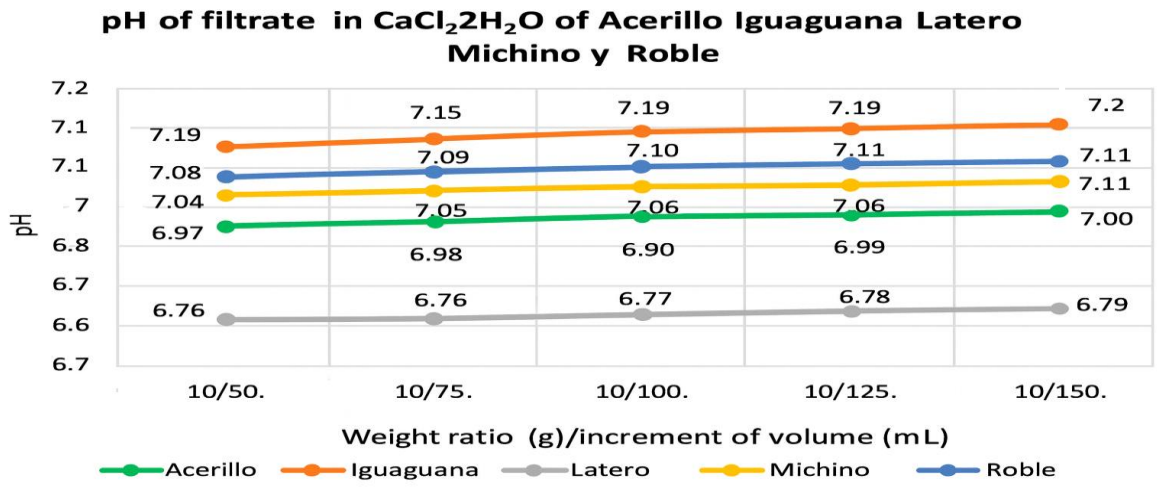
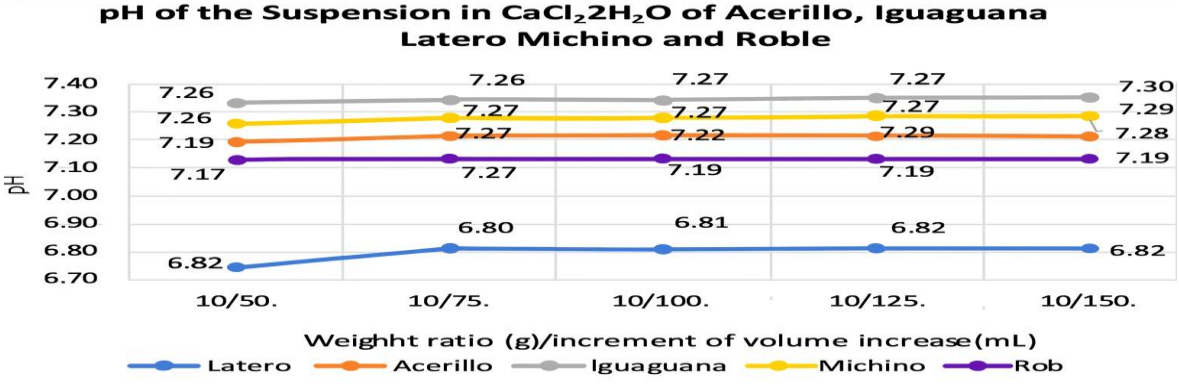


Figure 2 pH of the woods Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez in the suspension using$_{CaCl}$ 2.2H2O.



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Determination of the dependence of the volume of the H2O extractor on the pH values of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez.

Figure 3 pH of the woods Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mix in the filtrate using water.

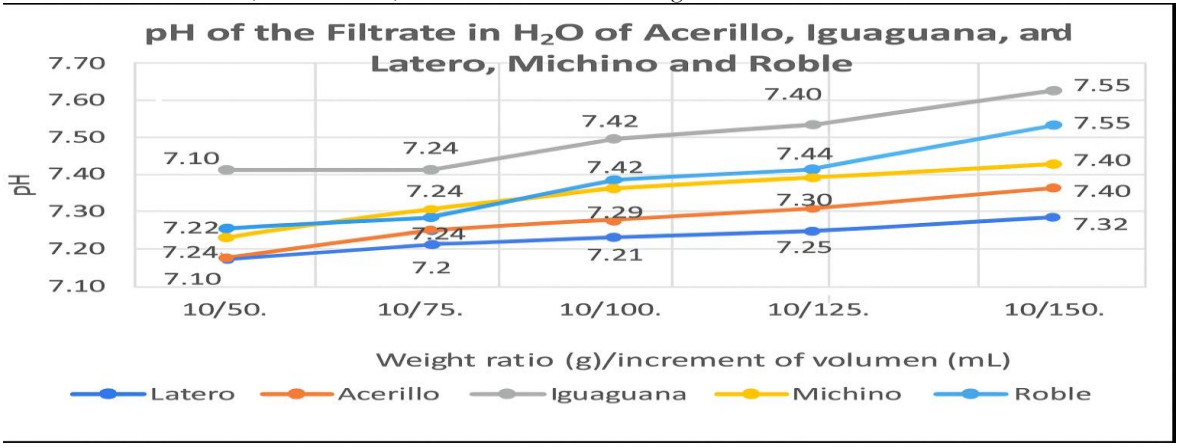

Figure 4 pH of the woods Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez in the suspension using water.

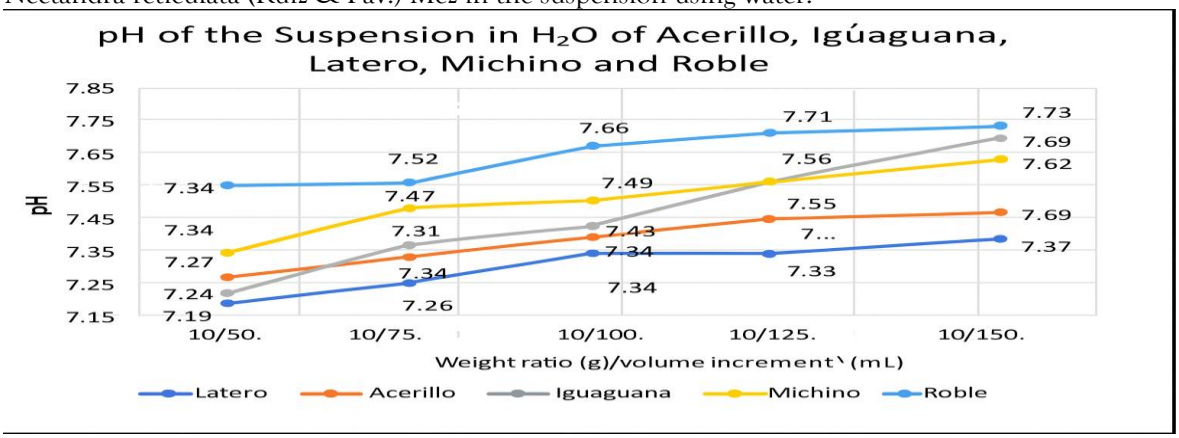

Table 1 Linear adjustment for the pH of CaCl2.2H2O filtrate and suspension and distilled water, for each species

Species	Extractor/condition	Equation	Earrings	Correlation coefficient (R2)
Aspidosperma polyneuron Müll.Arg	CaCl2.2H2O filtered	Y=0.007X+6.965	0.007	0.9423
	CaCl2.2H2O suspension	y = 0.0007x + 7.188	0.017	0.7015
	H2O filtered	Y=0.04X+7.14	0.04	0.8602
	H2O suspension	Y=0.0457X+7.2403	0.0457	0.9681
Cordia iguaguana Melch. ex I.M. Johnst	CaCl2.2H2O filtered	Y=0.012X+7.144	0.012	0.9
	CaCl2.2H2O suspension	y = 0.0002x + 7.322	0.005	0.8929
	H2O filtered	Y=0.0503X+7.3837	0.0503	0.9657

	H2O suspension	Y=0.113X+7.1117	0.113	0.9874
Licaria triandra (Sw.) Kosterm	CaCl2.2H2O filtered	Y = 0.008X+6.748	0.008	0.9412
	CaCl2.2H2O suspension	y = 0.0007x + 6.732	0.018	0.6639
	H2O filtered	y=0.0507+7.094	0.0507	0.8249
	H2O suspension	Y=0.045X+7.163	0.045	0.8885
Manilkara bidentata subsp. surinamesis (Miq.) T.D. Penn	CaCl2.2H2O filtered	Y=0.007X+7.035	0.007	0.9423
	CaCl2.2H2O suspension	Y = 0.0003x + 7.25	0.007	0.8167
	H2O filtered	y=0.045+7.197	0.045	0.8774
	H2O suspension	Y=0.064X+7.302	0.064	0.9455
Nectandra reticulata (Ruiz & Pav.) Mez	CaCl2.2H2O filtered	Y=0.008X+7.074	0.008	0.9412
	CaCl2.2H2O suspension	Y = 0.0002x + 7.16	0.005	0.7812
	H2O filtered	Y=0.07X+7.186	0.07	0.9548
	H2O suspension	Y=0.059X+7.455	0.059	0.9288

Table 2 Average slopes and correlation coefficients for CaCl2.2H2O and distilled water for filtering and suspension.

Species	Extractor/condition	Earrings	Correlation coefficient (R2)
Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez	CaCl2.2H2O filtered	0.0084	0.9334
	CaCl2.2H2O suspension	0.01	0.7912
	H2O filtered	0.05	0.9
	H2O suspension	0.0652	0.9437

DISCUSSION

Figure 1 shows that for the extractant CaCl 2.2H2O 0.01M the pH value in the filtrate, of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez, range from 6.97 to 7.00, 7.15 to 7.20, 6.76 to 6.79, 7.04 to 7.07 and 7.08 to 7.11 respectively.

Figure 2 shows that for the extractant CaCl 2.2H2O 0.01M the pH value in the suspension, of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez, range from 7.20 to 7.28, 7.33 to 7.35, 6.74 to 6.82, 7.26 to 7.29 and 7.17 to 7.19 respectively.

Figure 3 shows that for the extractant $H_{2O\ the}$ pH value in the filtrate of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez range from 7.15 to 7.32, 7.45 to 7.64, 7.27 to 7.55, 7.21 to 7.40 and 7.15 to 7.39 respectively.

Figure 4 shows that for the extractant $H_{2O\ the}$ pH value in the suspension of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez range from 7.27 to 7.45, 7.22 to 7.69, 7.19 to 7.37, 7.27 to 7.72 and 7.52 to 7.73 respectively.
From this it can be deduced that the pH values obtained indistinctly from the extractor will be higher for the suspension.
The increase in water volume directly influences the pH value of the samples.
Millán et al. (2017) show similar values for materials with the same texture as sawdust, the effect of suspension involves contact with the electrode with the suspended solids. Pérez et al (2010) mention that many colloidal or small particles, in contact with a polar liquid, such as water, spontaneously acquire a surface electrical charge, leading to the appearance of the so-called interfacial properties. The density of electric charge acquired by particles generally depends on the pH of the suspension, the ionic content of the medium and the chemical composition of the solid phase. This explains the differences in the measurements in filtration and suspension.
From Figure 1 for the results of the pH measurement in the filtrate, using CaCl2.2H2O 0.01M, it is evident that the species Cordia iguaguana Melch. ex I.M. Johnst, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez have a slightly alkaline pH and the Acerillo and Latero species have a slightly acidic pH.
From Figure 2 for the results of the measurement of pH in the suspension, using CaCl2.2H2O 0.01M, it is evident that the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez shows a slightly alkaline pH and the Latero species has a slightly acidic pH, when measured in filtration.
The pH values obtained with CaCl2.2H2O 0.01 M in filtration and suspension, are more constant, as they do not show dependence on the increase in volume, with respect to those obtained with distilled water.
Millan et al (2017) indicate that this is due to the "dilution effect". The lower pH values obtained by using $CaCl_2$.2H2O 0.01 M, is due to the fact that this neutral salt dissociates the additional hydrogen ions in relation to the water. The dissociative effect is favored by the time of contact.
Tables 1 and 2 show the linear adjustments and the quadratic correlation coefficients (R2) corresponding to each adjustment for the pH values in the filtrates and suspensions obtained using CaCl2.2H2O 0.01M and H2O.
The slopes of the linear equations are lower for the pH values obtained with CaCl2.2H2O 0.01M, both in the filtrate and in the extract, this means less dependence on pH with the increase in volume of the extractor.
The average square correlation coefficient 0.9334 obtained from the pH values of the filtrate with CaCl2.2H2O 0.01 M, shows less dependence on the increase in extractor volume, since it has the lowest slope 0.0084; and the lowest net variation in pH between the values corresponding to the 10g/75 ml, 10 g/100 ml and 10g/125 ml ratios.

CONCLUSIONS

The pH values of the sawdust samples of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez are higher in suspension than in filtering.
The increase in water volume in both the filtrate and the suspension increases the pH values of the sawdust samples of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez.
The conditions that showed less dependence were those that presented less slope, this occurred to determine the pH values of the sawdust samples of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez, in the filtering using 2.2H2O 0.01 M CaCl solution.

The pH values of the sawdust samples of the species Aspidosperma polyneuron Müll.Arg, Cordia iguaguana Melch. ex I.M. Johnst, Licaria triandra (Sw.) Kosterm, Manilkara bidentata subsp. surinamensis (Miq.) T.D. Penn and Nectandra reticulata (Ruiz & Pav.) Mez, show independence of 2.2H2O CaCl volume in the range of 75 ml to 125 ml.

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