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Influence of water on ethanolic extraction yield of *Azadirachta indica* leaf

Abstract

For the solid-liquid extractions of plants such as neem (Azadirachta indica) happen, there must be a concentration gradient between two phases (solvent and solute). Thus, the moisture of the vegetable and the solvents used, such as hydroethanolic solutions, interfere in the production of crude extracts. Thus, the present work had the objective of the study of the solid-liquid extraction of solubles from the fresh neem leaf, evaluating the influence of hydroethanolic solvents. To determine moisture, the samples of fresh leaves (n=6) were dehydrated in an oven at 105ºC according to the gravimetric method. The solid-liquid extracts were developed in laboratory cutter (n=3) with 93g of neem "in natura" sheet, using ethyl alcohol P.A. 99.8º GL and hydroethanolic solutions 50 and 20ºGL. The results obtained show that the dry extract produced by extraction with ethyl alcohol PA 99.8ºGL was 231.4% higher when compared with that obtained with the 50ºGL hydroethanol solution and 242.6% higher when compared with the 20ºGL hydroethanolic solution, demonstrating the importance of solvent selection and the influence of water on the extraction of soluble vegetables.

Keywords: solid-liquid extraction, crude extract, hydroethanolic extract, neem

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Introduction

The solid-liquid extraction occurs when there is mass transfer due to the existence of a concentration gradient between two phases, in which the soluble is extracted by entering in contact with a solvent.[1] With that, the yield of the leaf extracts of the *Azadirachta indica* is directly correlated with the solvent used, once, as demonstrated by Fick's second Law, as shown in Equation 1, the diffusion rate will be higher, the greater the concentration variation between the phases.[2–4]

$$\frac{\partial CA}{\partial t} = Dab\nabla^2 CA \qquad (1)$$

Different solvents are used to obtain crude extract of dry leaves of *A. indica*. The extraction of total soluble from the fresh leaves is little studied, and they are usually used frequently in rural properties. Dried leaves extracted with N, N-Dimethylformamide, present antibacterial activity in *Staphylococcus aureus* and *Escherichia coli*, suggesting the incorporation of the extract in packages giving antibacterial activity in this material.[5] The ethanolic extract of the dried leaves shows cicatrizant effect in the colitis induced in rats and antibacterial activity against *Escherichia coli* ATCC 25922, *Shigella boydii*, *Shigella sonnei* and *Shigella flexneri*, present in the intestine.[6] On the other hand, the aqueous extracts of the dried leaves present a non-sticky effect of *Candida albicans*, suggesting their use in the prevention of diseases of the oral cavity.[7] The Brazilian population uses hydroethanolic extractions of fresh neem leaves, because it is simpler and more economical in relation to the dry leaves extract, which justifies this study.

Neem sheet moisture

It was used 9g of neem fresh leaves, which were taken to the oven at 105ºC, to determine the humidity, through the difference between the mass of the fresh leaf and the mass of the dehydrated leaf (constant mass), according to gravimetric method of humidity,[8] where it was obtained a content of humidity of 75.03%, with a coefficient of variation of 1.34%.

Solid-liquid extraction

The solid-liquid extractions (400mL solvent/extraction) were performed in batch with the use of cutter (10L). The solvents used was the ethyl alcohol P.A. 99.8°GL and the hydroethanolic solutions of 50 and 20°GL, prepared with deionized water and measured with Gay Lussac alcoholometer.

For these extractions, 93g of fresh neem leaves were used. The solvents of the extracts obtained were evaporated at 40°C, followed by dehydration in an oven at 105°C for 48 hours, and weighed in analytical balance. It was decided to use the vegetable neem in natura, since the active compound, azadirachtin, degrades at a temperature above 40°C. In addition, farmers use fresh neem leaf for direct application. After the extractions, the ethanol P.A. 99.8°GL had extracted 1.754±0.182g of dry extracts. The 50°GL hydroethanolic solution extracted 0.758±0.050g and the 20°GL hydroethanolic solution extracted 0.723±0.069g, according to Table 1. The results demonstrated are in accordance with the studies carried out by Chaudhary et al.,[9] in which the active components of the neem vegetable have been shown to have little solubility in water and high solubility (and may be complete) in organic solvents such as alcohols, hydrocarbons, ethers and ketones (Table 1).

In addition, it is noted that the amount of dry extract obtained with the hydroethanolic solution 50°GL (0.758±0.050g) relative to the 20°GL hydroethanolic solution (0.723±0.069g) was very close. In view of this, the use of the 20°GL hydroethanolic solution is indicated for the cost reduction of the extraction stage, with the commercial value of the water being lower than that of ethanol.

Table 1 Relationship of dry extracts obtained with alcohol and hydroethanolic solutions (99.8, 50.0 and 20.0°GL) in the industrial cutter

Solvent	Dry extract (g)			
	n1	n2	n3	average (g)
Ethyl alcohol P.A. 99.8°GL	1.740	1.535	1.989	1.754±0.182
50°GL hydroethanolic solution	0.787	0.701	0.787	0.758±0.050
20°GL hydroethanolic solution	0.767	0.758	0.644	0.723±0.069

Conclusion

The water content in hydroethanolic solutions influences the yield of the solid-liquid extraction when compared to the extracts obtained from the use of ethyl alcohol P.A. 99.8°GL. As the extracts are formed mainly from organic compounds, they are better solubilized by organic solvents, such as ethyl alcohol P.A. 99.8°GL as demonstrated in the results obtained in this study.

The study of the influence of the water in obtaining the crude extract is necessary since the leaves of the vegetable can be used in fresh form, the water present in the vegetable becomes part of the composition of the extraction solvent, when miscible, interfering in the types of total extractable solids.

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Conflicts of interest

The authors declares there is no conflicts of interest.

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