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ET1CLEANEXTRACT: REMOVAL OF TOXIC COMPOUNDS FROM NATURAL EXTRACTS USING GREEN TECHNIQUES

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INTRODUCTION

The extraction of healthy compounds from fruit and vegetable waste makes these compounds organic, non-toxic and biocompatible together with the simultaneous use of the waste, thus reducing the risks of waste accumulation in the environment. Therefore, the treatment of fruit waste through different techniques such as landfilling or incineration can be avoided to prevent the negative effect on the environment, as well as the cost of investment in the process.

The extraction of value-added products from organic waste produces by-products that are used as a main ingredients for other production processes. Researches carried out by the CTC and scientific publications have shown that the residue obtained after the extraction processes of compounds of interest such as proteins, vitamins, pigments and phenolic compounds, can be used to adsorb different types of pesticides and heavy metals such as nickel, cadmium, arsenic, chromium, etc. from polluted water due to the surface properties of the residues.

This project aims to develop technologies for the removal of toxic compounds (pesticides) from natural extracts using low-cost adsorbents, without decreasing the concentration of the compounds of interest as a result of the adsorption process.

OBJECTIVES

- Development of low-cost purification processes of natural extracts for the removal of toxic compounds, such as pesticides, avoiding the loss of the compounds of interest present in the extract.
- Obtaining low-cost adsorbents from agricultural residues, agri-food industry and plant origin.
- Development an industrial scale extraction process of compounds of interest, proteins, vitamins, with high purity and free of toxic compounds, pesticides.

METHODOLOGY

Different natural adsorbent materials have been obtained from agricultural and food industry residues, capable of retaining pesticides and toxic compounds in their pores.

For this purpose, they have been subjected to homogenization processes by crushing and sieving, with the aim of reducing the size and increasing the contact surface available for the adsorption of pollutants. In addition, the organic compounds, which produce the degradation of the biomaterial, have been reduced through the application of successive washes and the use of oxidation steps.

Different batches of artichoke and citrus extracts, containing pesticides, will be treated with the natural adsorbents obtained to obtain contaminant-free extracts. The methodology to be followed is shown in figure 1.

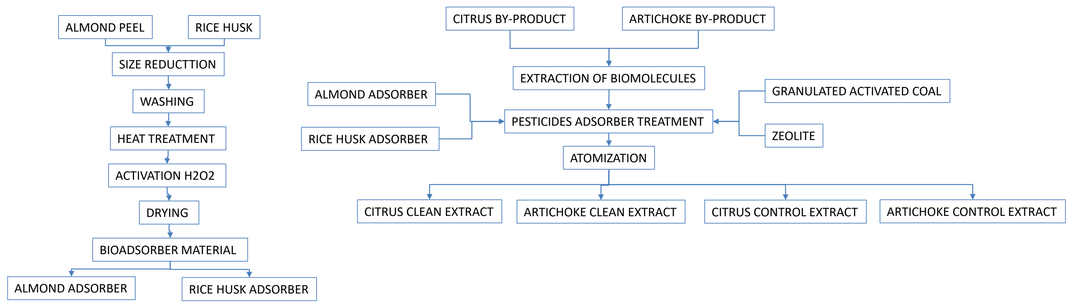

Figure 1. Methodology for obtaining contaminant-free extracts using natural adsorbents.

Table 1. Technical sheet of commercial adsorbers

PARAMETER	*GAC*	ZEOLITE
SUPLIER	PANREAC APPLICHEM	ZEOCAT
DESCRIPTION	CHARCOAL ACTIVATED GRANULATED Nº3 TECHNICAL GRADE	NATURAL ZEOLITE, CLINOPTILOLITE GRANULATED
PHYSICAL	POWDER, GRANULES, BLACK, INSOLUBLE IN WATER	POWDER, GRANULES, GREY, INSOLUBLE IN WATER
GRANULAR SIZE	0,5 -3,15 mm	1,0-3,00 mm

Picture 1. GAC

Picture 2. ZEOLITE

Table 2. Characterization of almond peel and rice husk

PARAMETER	ALMOND PEEL	RICE HUSK
FAT, g/100g	3,12	0,72
PROTEIN, g/100g	12,56	2,98
TOTAL CARBOHYDRATES, g/100g	75,51	82,14
ASH, g/100g	8,81	14,16
TOTAL FIBER, g/100g	37,42	68,21
ORGANIC MATERIAL, %	97,10	84,54
OXIDABLE, %	57,38	44,93
TOTAL ORGANIC CARBON, %	50,53	45,99

Picture 3. ALMOND PEEL

Picture 4. RICE HUSK

A comparison of these natural adsorbents will be made with commercial adsorbents used for pesticide removal.

RESULTS AND DISCUSSIONS

Two natural adsorbent materials have been obtained from the residues almond peel (picture 3) and rice husk (picture 4) The methodology applied for the activation of the materials was application of physical, chemical, thermal treatments. Table 3 show the characterization of activated natural adsorber materials. Figure 2 show the % of pesticide reduction in contaminated water after the treatment with activated almond and rice adsorber.

Table 3. Characterization of activated almond peel and rice husk material

PARAMETER	ALMOND PEEL	RICE HUSK
WATER ACTIVITY, aw	0,47	0,27
ORGANIC MATERIAL, %	95,95	80,11
OXIDABLE MATERIAL, %	34,13	23,19
MESOPHILIC AEOROBIC, ufc/g<	<10	<10
MOULD AND YEAST, ufc/g	<10	<10

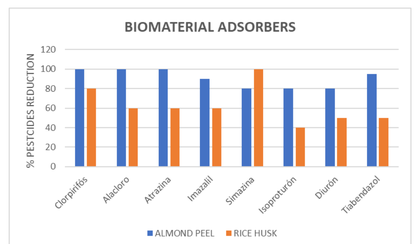

Figure 2. Reduction of pesticides through natural adsorbents

A citrus extract (picture 5) and artichoke extract (picture 6) were produced as control samples. Table 4 shows the characterization of citrus by-product and control extract. Table 5 shows the characterization of artichoke by-product. The characterization of the artichoke control extract is on going.

PARAMETER	CITRUS PEEL	CONTROL CITRUS EXTRACT
VITAMIN C, mg/kg	311	<55
LIMONINE, mg/kg	11	57
HESPERIDIN, mg/kg	3574	5234
ESSENTIAL OILS, %	4,9	2,91
DIETARY FIBER, g/100 g	6,7	83,9
MOISTURE, g/100 g	85,7	<0,1
TOTAL FATS, g/100 g	0,1	2,1
PROTEINS, g/100 g	0,9	8,0
ENERGY VALUE, Kcal/100g	43	228
TOTAL CARBOHYDRATE, g/100 g	6,2	2,3
ENERGY VALUE, kJ/100G	178	924
SODIUM CHLORIDE, g/100 g	0,08	0,84
TOTAL ASH, g/100 g	0,4	3,7
TOTAL SUGARS, g/100 g	5,2	0,13
SATURATED FAT, g/100 g	<0,10	0,75
Pathogens, /25g	Absence	Absence
Mold and yeast, ufc/g	2200	<10
Aerobic mesophilic, ufc/g	15000	300
IMAZALIL, mg/kg	3,55	10,1
PYRIMETHANIL , mg/kg	0,94	7,33
PYRIPROXYFEN, mg/kg	0,012	0,60
2-FENILFENOL, mg/kg	1,91	0,12
AZOXISTROBINA , mg/kg	<0,01	0,01
ESPIRODICLOFENO , mg/kg	<0,01	0,010
HEXITIAZOX , mg/kg	<0,01	0,012
FLUDIOXONIL , mg/kg	<0,01	0,046

PARAMETER	ARTICHOKE BY-PRODUCTS
VITAMIN C, mg/kg	<55
CAFFEINE AC, mg/kg	2,5
CLOROGENIC AC, mg/kg	65,7
CINARINE, mg/kg	9,8
DIETARY FIBER, g/100 g	7,1
MOISTURE, g/100 g	82,8
TOTAL FATS, g/100 g	0,2
PROTEINS, g/100 g	2,5
ENERGY VALUE, Kcal/100g	52
TOTAL CARBOHYDRATE, g/100 g	6,4
ENERGY VALUE, kJ/100G	216
SODIUM CHLORIDE, g/100 g	0,17
TOTAL ASH, g/100 g	1,0
TOTAL SUGARS, g/100 g	1,7
SATURATED FAT, g/100 g	<0,1
Pathogens, /25g	Absence
Mold and yeast, ufc/g	3000
Aerobic mesophilic, ufc/g	2000
AZOXISTROBINA, mg/kg	0,023

Picture 5. Citrus extract

Picture 6. Artichoke extract

The comparison of the adsorption treatment of pesticides with commercial adsorbent matrices, GAC and zeolite and two natural material adsorbers (almond peel and rice husk) will be carried out in production of artichoke clean extract and citrus clean extract. In addition, the nutritional analysis of clean extracts and control extracts will be done with the aim to validate the effects of use adsorbents.

CONCLUSIONS

- ***DIFFERENT NATURAL ADSORBENTS HAVE BEEN OBTAINED FROM BY-PRODUCTS OF THE FOOD INDUSTRY.***
- ***THE COMPARATIVE OF PESTICIDE REMOVAL BY ADSORPTION PROCESSES WITH NATURAL ADSORBENTS MADE FROM ALMOND PEEL AND RICE HUSK AND WITH COMMERCIAL ADSORBENT MATERIALS GAC AND ZEOLITE IS BEING STUDIED.***
- ***THE DEVELOPMENT OF CONTAMINANT-FREE ARTICHOKE AND CITRUS EXTRACTS IS UNDERWAY.***

REFERENCES

- *Gupta N., Poddar K., Sarkar D., Kumari N., Padhan B., Sarkar A. (2019). Fruit waste management by pigment production and utilization of residual as bioadsorbent. Journal of Environmental Management. V 244, pp 138-143.*
- *Ayuso Miguel. 2019. Aplicación de tecnologías de estabilización a biorresiduos para su valorización como material absorbente de moléculas orgánicas – ET4ADSORPLUS. EXP. 2019.08.CT01.0009. Centro Tecnológico Nacional de la Conserva y Alimentación.*
- *Mallek M., Chtourou M., Portillo M., Monclús H., Walha K., ben Salah A., Salvadó V. (2018). Granulated cork as biosorbent for the removal of phenol derivatives and emerging contaminants. Journal of Environmental Management, 223: 576-585*

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