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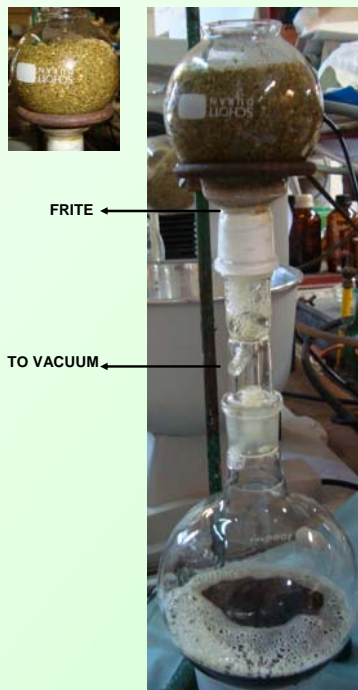
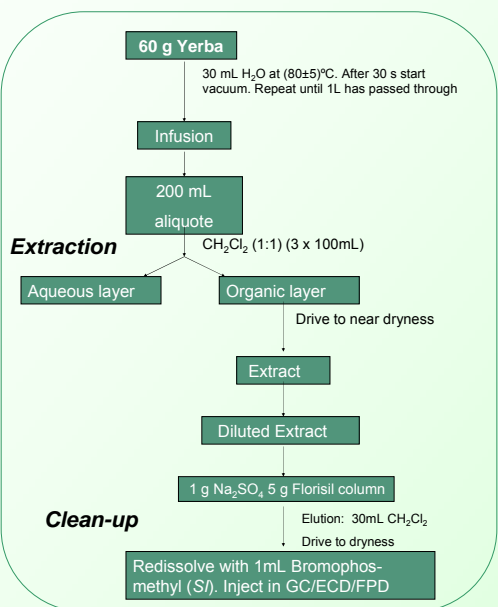
Introduction

Maté is a beverage known for its stimulating properties. It is an infusion made from Yerba maté (*Ilex paraguariensis*) which is one of the most consumed herbs in South America. Maté consumption involves different traditions of each region, but in Argentina, Southern Brazil and Uruguay the infusion is drunk in almost in the same way: small portions of hot water are poured over a certain amount of yerba maté contained in a curbi and the resulting infusion is drunk by sucking through a silver pipe some minutes after hot water was added to the herb [1]. Uruguay with 8 Kg per capita/year is the largest maté consumer which means roughly 400 mL Maté /day/person. Due to the peculiar way of drinking Maté, the residues of pesticides, that are currently used in *Ilex* plantations, are extracted in different proportions than in a normal infusion. No MRL are settled for pesticide residues in the regional or international regulations. Therefore, in order to evaluate properly the contribution of maté to the daily pesticide residue intake by our population, maté drinking has to be modeled and the extraction of pesticides residues in that conditions evaluated. In this work we present a experimental simulation model of maté drinking and the analytical approach for the determination of 11 organophosphates, 5 synthetic pyrethroids, α - β endosulfan residues in maté infusion. Some of these pesticides are currently found in commercial samples of Yerba maté [2].

Experimental

Spiking procedure:

- > 4 g of P.U.1 yerba mate sample was spiked with 100 μ g/mL pesticide standards in acetone.
- > Yerba Maté was added following a geometric progression to 64 g. Each mixing step was performed during 1 hr in a rotary evaporator.
- > 4 replicates at 1 μ g/g were performed.

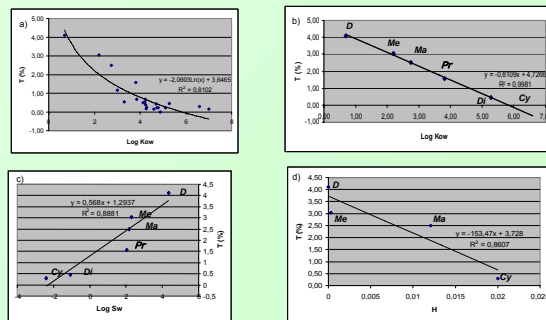


Results & Discussion

A simple device that simulates the extraction procedure during mate drinking is presented. The extraction process is different from a normal infusion [2,3]. Pesticide transfer to hot water is governed by different mechanisms and is presented at the following table:

	Transfer (%)	RSD (%)	log Kow (20-25°C)	log Sw (mg/L)	H (Pa m3 mol-1)	Recovery (%)	RSD
Diazinon	0,53	18,32		1,78	6,09E-02	64,2	14,3
Dimethoate	4,11	21,71	0,704	4,37	1,42E-06	64,2	15,7
Propetamphos	1,57	6,84	3,82	2,04		74,3	8,1
Chlorpyrifos	0,43	6,88	4,7	0,15	6,76E-01	101,1	4,7
Dichlofention	0,46	4,00	5,27	-1,07		94,3	2,2
Parathion-methyl	1,15	8,71	3	1,74	8,57E-03	118,2	17,6
Pirimiphos-methyl	0,52	6,08	4,2	1,00	6,00E-02	87,6	13,2
Chlorpyrifos-methyl	0,37	5,84	4,24	0,41	3,72E-01	83,4	7,1
Malathion	2,50	2,34	2,75	2,16	2,21E-02	91,2	15,4
(Z)-Chlorfenvinphos	0,68	-	3,85	2,08		99,4	9,2
(E)-Chlorfenvinphos	0,68	18,75	4,22	0,86		89,4	9,2
Methidathion	3,04	3,97	2,2	2,30	3,30E-04	128,2	14,7
Ethion	0,25	5,36	4,28	0,30	3,85E-02	94,5	2,4
Coumaphos	0,51	17,68	4,13	0,18	3,14E-03	78,2	7,3
Endosulfan a	0,22	24,20	4,74	-0,48	1,48E+00	112,5	14,2
Endosulfan b	0,22	24,20	4,79	-0,49	7,00E-02	112,5	14,2
L-Cyhalotrin	0,15	28,16	7	-2,30	2,00E-02	124,5	22,8
Cypermethrin	0,29	24,30	6,6	-2,40	2,00E-02	140,2	25,7
Fenvalerate	0,21	11,25	5,1	-5,00		116,3	14,7
Deltamethrin	0,14	15,42	4,6	-5,70	3,13 E - 2	178,3	18,4
T-Fluralinate	0,17	18,31	4,28	-8,99	4,04E-05	105,7	13,2

Table 1. Transfer (%) with their RSD (n=4), physicochemical parameters [4] and recoveries at 1 mg/L of the selected pesticides.



Figures. a) T(%) vs log Kow of all pesticides. b) T(%) vs Log Kow c) T(%) vs Log Sw, d) T(%) vs H. D=dimethoate, Me=methodathion, Ma=malathion, Pr=propetamphos, Di=dichlofention, Cy=cypermethrin.

There is no clear relationship between Kow and transfer of pesticides to the brew (see Fig.a). This suggest that there is a combination of mechanisms acting in the extraction process.

However, there is a lineal correlation between T(%) vs log Kow for some pesticides with markedly different physicochemical properties (see Fig b). The same trend was observed with T(%) vs H and inversely with T(%) vs log Sw (see Fig. c & d).

For those are generally met:

- > T S_w
- > T $1/K_{ow}$
- > T $1/H$

Conclusions

The present study revealed that during maté drinking consumption pesticides residues are extracted, particularly pesticides with high water solubility.

Although non linear relationship between physicochemical properties such as Kow, Sw or H with transfer of pesticides was found, predictable trends in extraction rates can be obtained with those selected variables.

To prevent any health problems to consumers, the establishment of MRL for pesticide residues in yerba maté should be considered. This study can help to understand the real fate of pesticides during maté drinking.

References

- [1] Vázquez A & Moyna P, *Journal of Ethnopharmacology*, **1986**, 18, 267-272
- [2] González J. et al. Poster EPRW, **2006**
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