REESEARCH FOR OBTAINING FROM AFFORDABLE NATURAL MINERAL SOURCES, AGREED TO REPLACE SOME SYNTHETIC ANIMAL FEED ADDITIVES

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The current project refers to studies of the composition of natural nutritive substances carried out on inexpensive plant material, that result as by-products in processes for obtaining certain phytotherapeutic preparations from sea buckthorn (Hippophäe rhamnoides) leaves, the by-product cakes resulting from the extraction of green barley (Hordeum vulgaris) juice, Jerusalem artichoke (Helianthus tuberosus) tubers, the above-ground parts of pendant amaranth (Amaranthus caudatus), with regards to utilising these as natural animal feed additives.

Content in minerals, proteins, enzymes, sugars, flavones, and PPCAs, as well as the antioxidant capacity of the plant materials and certain enzymes of interest for animal nutrition were studied.

The results obtained are favourable, indicating as much a great variety and quantity of minerals (over 15 - 20) in all of the plant products researched, and protein quantities (of over 12%) that are competitive with those of cereal products.

***Key words**: feed additives, minerals, proteins ,enzymes*

Judicious nutrition of swine is very important for the health of zootechnical lots, for meat quality, for improvement of digestive absorption yield and assimilation of nutrients [6].

Minerals are important components of animal feed, that have numerous physiological implications in: the development of the skeleton, the maintenance of osmotic pressure in the body, a certain pH in diverse parts of the body, for the dispersion of colloidal particles, for a normal redox state, for immune potential that is within normal parameters, for solubilising proteins, for normal muscle firing, and for the potentiation of many enzymes [3], [8], [9], [10].

Mineral metabolism influences meat quality, lactation, reproduction, morbidity and mortality indices.

The role of calcium and magnesium in the formation of bony tissue is remarcable, the distribution of Ca in the skeleton being 80%, while for Mg it is circa 70%, phosphorus is also implicated in this process [10].

The digestive absorption of minerals and oligoelements from animal feed is influenced by many factors: organic and inorganic compounds that have the capacity to form chemical complexes with metallic cations, amino acids, acetic acid, lactic acid, butyric acid, citric acid, etc. [2]. Sugars (fructose and polyhydroxylated compounds) help in absorbing boron by forming internal combinations. [7] Flavones have the capacity to form chelates with bi- and tri-valent metals, contributing to their absorption and digestive assimilation. Polyphenoxycarboxylic acids (PPCAs) increase bile flow and improve nutrient absorption processes [4]; antinutritive substances that can inhibit this absorption are for example: alkaloids, glycosides, enzymatic inhibitors, phytates (for non-ruminant animals such as swine in this case), etc. as well as protein deficiencies; taking into account optimal ratios between the minerals: Ca/P, Fe, Mg, Al; Ca, P; Cu/S; Fe/I; Ca/Zn; Zn/Cu. The feeding instincts of swine can not avoid deficiency syndromes and and toxicoses, there being too few instances recorded of reaction in Ca deficiency (geophagia) and in Fe deficiency anæmic swine chewing at metal gratings. Mineral deficiencies in animal feed are often tied to the relationship of soil-plant-animal (enzootics).

Table 1

Daily needs for minerals in pig fattening [1]

Macro-element	Swine under 50 kg	Swineover 50 kg	Micro-element	mg/kg combined feed
Calcium (g)	12-15	15-20	Copper	3-6
Phosphorus (g)	10-12	12-15	Iron	10-30
Potassium (g)	6-8	8-10	Manganese	30-50
Sodium (g)	2-3	3-4	Zinc	40-50
Chlorine(g)	4-5	5-6	Iod	0,2-0,5
			Selenium	0,1-0,2

MATERIAL AND METHOD

Based on documentation in specialised literature and on our experimental data, four raw materials from plants were selected (that were rich in minerals and other components that are easily assimilable), that are by products of industrial processing: dried sea buckthorn leaves (*Hippophäe rhamnoides*) (PFC); cakes resulting from the pressing of green barley for juice (*Hordeum vulgaris*) (PTO); the aerial parts of pendant amaranth (*Amaranthus caudatus*) (PTA); Jerusalem artichoke tubers (*Helianthus tuberosus*) (PTT).The effective content in minerals and trace elements was determined by spectrometry and atomic absorption, other chemical components were determined by methods according to the European Pharmacopœia and other methods validated at Hofigal S.A., while enzymatic activity was evaluated by more well-known (volumetric) methods as well as reflectometriq appliances utilising RQ-Flex apparatus.

REZULTS AND DISCUSSIONS

Table 2

Macrominerals and microminerals concentrations of selected plant materials (mg%)

Name probation	Ca	Mg	Na	K	Mn	Fe	Zn	Cu	Pb
Leaf powder SeaBuckthorn (PFC)	1600	150	500	200	12	60	4,6	1	0,1
Barley green powder cake (PTO)	360	170	45	1300	5	90	8	-	0,3
Powder cake amaranth (PTA)	1300	1300	25	3200	2	10	5,5	0,5	0,4
Jerusalem tubers (PTT)	170	240	20	1700	10	150	3,5	2,0	0,3

A balanced content of macrominerals (Ca, Mg, Na, K) and microminerals (Mn, Fe, Zn,Cu) was found, however the content in toxic metals is below the permitted levels.

Among other nutritional components of the plant material studied to determine total protein. The highest content of protein were found in sea buckthorn leaves (PFC) (16.68 g%), followed by Jerusalem artichoke tubers (PTT), amaranth (PTA) and barley green powder (PTO) (*figure 1*).

In *Figure 2* the highest values of total sugars were found in Jerusalem (25.32 g%), while reducing sugar in the barley leaves- (11.02 g%).

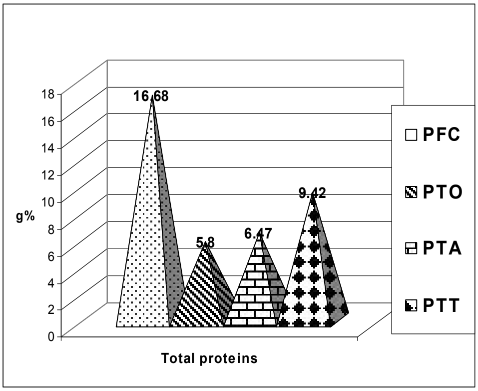

Figure 1 **Protein from plant material**

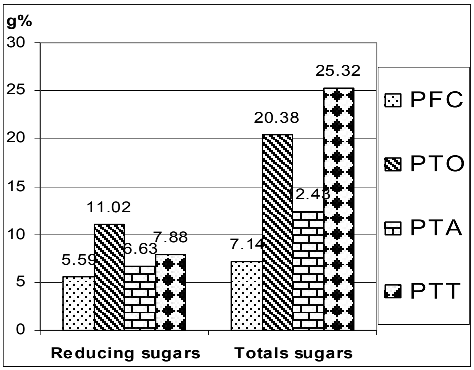

Figure 2 **Reducing sugars and total sugars from plant material**

High concentrations of PPCAs were found in sea buckthorn leaves (2.42 g%), followed by far lower concentrations in barley leaves (0.29 g%), Jerusalem artichoke (0.21g%) and pendant amaranth (0.19g%), however barley leaves had the highest concentration in flavones, (0.14g%)> sea buckthorn leaves (0.06 g%)> pendant amaranth (0.01 g%)> Jerusalem artichoke (0.0057g%).

From the data obtained, a higher activity level for amylase from barley leaves and a higher level of lipase from pendant amaranth was found (fig 3).

Studying the activity of the enzyme SOD in the selected raw materials shows higher levels for sea buckthorn leaves (138 UI/20 mg guinea pig brain protein), followed by pendant amaranth (16 UI/20 mg) and Jerusalem artichoke (181UI/50 mg) [5].

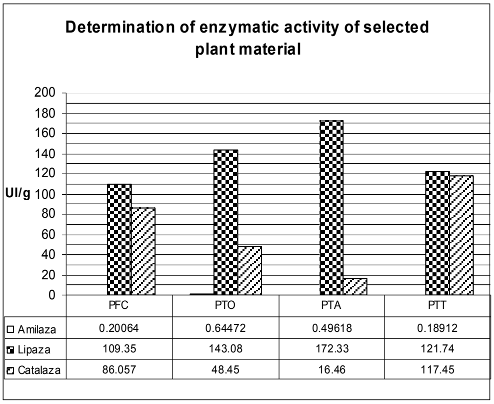

Figure 3 **Determination of enzymatic activity of selected plant material**

CONCLUSIONS

1. The studies carried out have led to the establishment and qualitative standardisation of certain natural raw materials, very useful from a nutritional and economic point of view, being byproducts of the industrial processing of plants.

2. Methods of analysis were adopted and established for bioactive substances.

3. The plant materials studied present a complex and equilibrated composition in minerals and oligoelements, toxic elements being being under the admitted levels.

4. Besides minerals, there are a series of factors of assimilation: proteins with a large range of amino acids, vitamins, flavones, PPCAs, inulin and sugars that also act by their fermentation acids.

5. Enzymatic activity, represented by amylase and lipase contribute to improving the digestive process, while SOD and CAT enzymes contribute to combatting oxidative stress, a prerequisite for a normal metabolism.

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