CENTRE D'ETUDE &
DE VALORISATION
DES ALGUES

Detoxification properties of Apple pectin formulation, ProPectin.

VitaPro

FINAL REPORT

ProPectin

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1. Recall

VitaPro is a company selling a patented formulation of pharmaceutical grade apple pectin as a nutritional supplement for detoxification, cholesterol management and blood glucose management applications.

Centre d'Etude et de Valorisation des Algues (CEVA) was established in 1982. It provides to its customers expertise, information centre, laboratories and pilot plant facilities for studies, and development of innovating products.

2. Work programme

2.1. Proposed study - Detoxification Properties of apple pectin extract

The aim of this study is to quantify the chelating effect of ProPectin on selected heavy metals, known as toxic for human health.

A known amount of apple pectin extract will be set in chemical conditions mimicking human digestion (see below). A mixture of heavy metals (Cd, Sn Hg, Pb) will be added to the solution at concentrations above the average security limit defined for daily food intake.

Samples will be analysed for individual metal concentrations using ICP-OES techniques. Sampling will be performed along the digestion process, as described above. The experiment will run at the same time as Part 1, using same samples.

In case of high detox properties, metals will be chelated by pectin and will not pass through the UF membrane. In case of weak detox properties, metals will pass the membrane. Potential hydrolysis of pectin may impact detox properties.

3. Results

3.1. Sampling Strategy

- Initial raw product tested in our experiments :

Our References	Customer References
2015-NV-003	**VitaPro ProPectin (powder formulation)**

- **Step 1** : Solutions before digestion experiments
  - Solutions of pectin samples dissolved in water = T_0
- **Step 2** : Gastric digestion (pH 2, 37°C, with pepsin)
  - After 1 H at 37°C : sampling of the solution = T_1
- **Step 3** : Partial intestinal digestion (pH 7.5)
  - 2 H at 37°C, then 1 H at 4°C to stop process
  - Centrifugation of the solution,
    - sampling of supernatant = T_2
    - Sampling of solid phase (if any) = "**culot**"
- **Step 4** : Simulation of intestinal absorption
  - Filtration trough Ultra-Filtration membrane set at 3 000 Da (3 kDa).
  - Retentat = T_3
  - Permeat = T_4

3.2. Part 0 – Analysis of ProPectin

Our References	2015-NV-003	Precisions of the analysis
Customer References	VitaPro ProPectin	
Entire Product		
Dry matter	98.1	5 %
Mineral content	0.2	10 %
Dissolved Polysaccharides		
Galactose	1.9	20 %
Glucose	0.6	20 %
Xylose	< 0.5	20 %
Rhamnose	0.5	20 %
Galacturonic acid	12.2	20 %
Glucuronic acid	< 0.1	20 %
Molecular weight[1]	168	10 %

Table 1 : Analytical results ProPectin. All concentrations are expressed in *%/raw = % in original product as it is delivered*.

Results discussion

- Natural Apple pectins are made of a mixture of polysaccharides rich in Galacturonic acid (Gal acid). Composition may vary according to apple species, season and extraction procedures, however a pure natural apple pectin is always rich in Galacturonic acid.

Conclusions

- The VitaPro ProPectin is an optimized formulation containing 27 % of pure pharmaceutical grade apple pectin and natural fructose. The profile of oses, galactose, galacturonic acid, glucose, xylose, rhamnose and glucuronic acid gives the composition of the polymer fraction of products containing the pectin and emphasizes the natural and high level of purity of apple pectin formulated in the VitaPro ProPectin product.

- VitaPro ProPectin serving is equivalent to 300 g of whole apple containing 1 % of pectin or 3 kg of whole apple containing 0.1 % of pectin.

3.3. Detoxification Properties of VitaPro ProPectin

Our References	*Expected*	NV-043 NV-048	NV-044 NV-049	NV-045 NV-050	***NV-046 NV-051***	NV-047 NV-052
Sample Description	T_x	T_0 before digestion	T_1 after digestion	T_2 supernatant	T_3 *retentat*[1]	T_4 permeat
Total Metals						
Lead, Pb (µg)	***285***	301	307	275	***210***	31
Cadmium, Cd (µg)	***48***	52	49	44	***35***	0
Tin , Sn (µg)	***250***	237	273	254	***199***	18
Mercury, Hg (µg)	***48***	52	57	50	***40***	6

Table 2 : Evolution of metal levels along the simulated digestion experiment with VitaPro ProPectin sample containing 4.8 g of apple pectin.

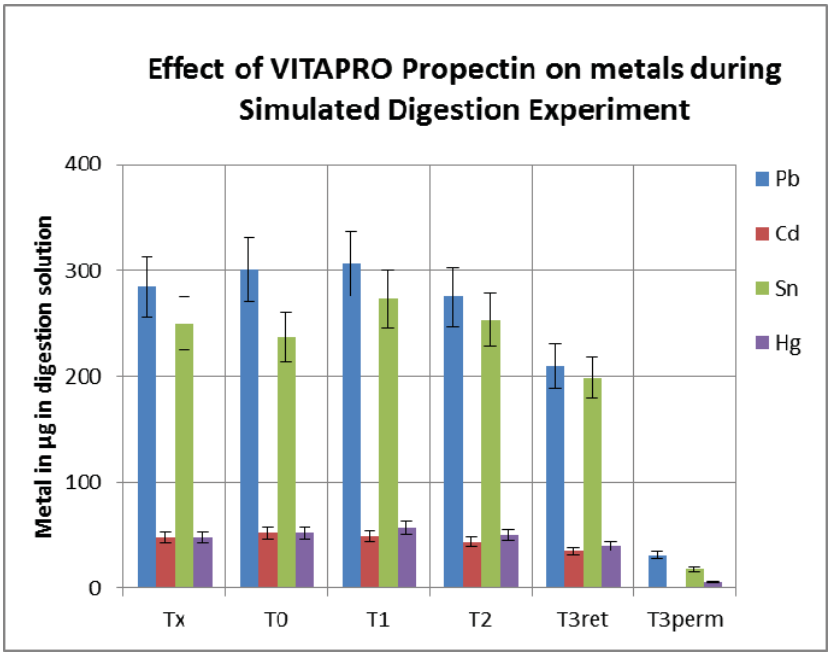

Figure 1 : Graph view of metal level evolution along simulated digestion experiment with VitaPro ProPectin (error bars for results precision). The amount of apple pectin in the experiment was 4.8 g (estimated from 2.2 g of Gal acid in T_0).

Analytical comments

- [1] corrected from 10% mass loss induced by UF membrane fouling
- There is a very good match between results of duplicated experiments

Results Discussion

- All metal salts are highly soluble. Without chelation they pass through the UF membrane
- The levels of metals were selected to be consistent with commonly recognized toxic levels in food. Limits for heavy metals daily intake recommended by FDA, EPA and ATSDR[1] are (averages, for a body weight of 70 kg) [2]:
    - 20 µg/day for Pb
    - 10 µg/day for Cd
    - 20 µg/day for Sn
    - 12 µg/day for Hg

Conclusions

- VitaPro ProPectin chelates Pb, Cd, Sn and Hg and so prevent their diffusion through the 3 kDa UF membrane. The chelating properties range up to 700% of the maximum daily dose for toxic metals.
- Extrapolated to real human digestion, it means that VitaPro ProPectin significantly decrease Pb, Cd, Sn and Hg absorption during stomach and early intestinal phases of the digestion. So, these toxic metals are not transferred to blood circulation at this stage of digestion, preventing their potentially detrimental effects.
- These chelation data were established using 4.8 g of pectin (about 18 g of ProPectin raw product) in contact with metal levels from 50 to 300 ppb during digestion experiment. In order to compare to other products these results need to be normalized with the level of pectin in servings (see table below).

Chelation Properties	µg / serving	µg / day
Lead, Pb	131	131
Cadmium, Cd	22	22
Tin , Sn	124	124
Mercury, Hg	25	25

Table 3 : VitaPro ProPectin detoxification properties for metals. Results are expressed in µg of metals chelated per serving and per day, assuming 1 servings /day as recommended by VitaPro. Each serving contains 3 g of pure apple pectin.

[1] www.atsdr.cdc.gov

[2] American Herbal Products Association. December2009. Heavy Metals: Analysis and Limits in Herba Dietary Supplements. AHP A: Silver Spring, MD

4. Report Conclusions

4.1. Product compositions

- In the table below we present a comparison in whole apple equivalent (assuming 0.2 % pectin level in natural apples and 150 g as average weight of apple)

	Whole Apple equivalent in g	**Whole Apple equivalent in number of apples**
VitaPro ProPectin 3 g apple pectin / serving	1 500 g	10 apples

- The VitaPro ProPectin is an optimized formulation containing 27 % of pure pharmaceutical grade apple pectin and natural fructose. The profile of oses, galactose, galacturonic acid, glucose, xylose, rhamnose and glucuronic acid gives the composition of the polymer fraction of products containing the pectin and emphasizes the natural and high level of purity of pectin formulated in the VitaPro ProPectin product.

4.2. Detoxification properties

- The figure below shows detoxification properties of VitaPro ProPectin. One daily dose of VitaPro ProPectin can prevent the absorption of toxic metals equivalent to several times the maximum daily intake limits recommended by EPA and FDA in food products.

- One serving per day of VitaPro ProPectin can prevent the absorption of :
    - 7 times the maximum daily dose for lead (Pb)
    - 2 times the maximum daily dose for cadmium (Cd)
    - 6 times the maximum daily dose for tin (Sn)
    - 2 times the maximum daily dose for mercury (Hg)

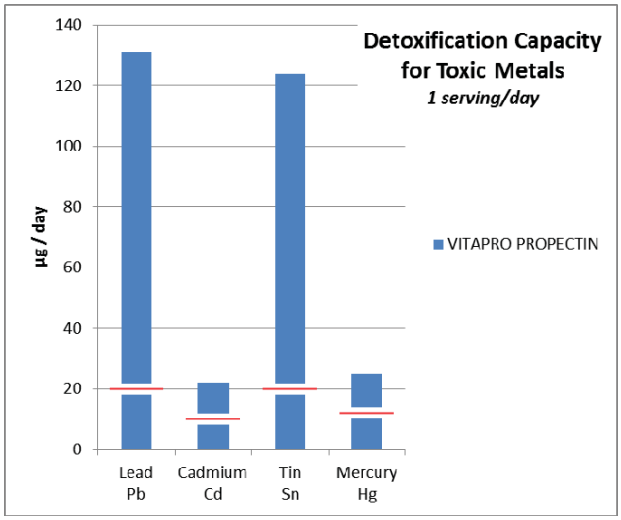

Figure 2 : VitaPro ProPectin properties regarding detoxification of toxic metals. Red bars are commonly accepted maximum limits for toxic metals level in food, expressed in daily intake for an adult with 70 kg body weight (from EPA, FDA).

VitaPro ProPectin	Chelation Properties compared to maximum daily dose for toxic metals
Lead, Pb	700% absorption
Cadmium, Cd	200% absorption
Tin , Sn	600% absorption
Mercury, Hg	200% absorption

Table 4 : VitaPro ProPectin efficacy regarding absorption prevention of toxic metals.