SUMMARY

***Keywords*: distillates, original distillation plant, topinambur (*Helianthus tuberosus* L.), berries.**

The PhD Thesis –„ *Biotechnologies and processing installation of distillates from fermentable and nonfermentable agricultural raw materials*", elaborated by the doctoral candidate Pop Octavian Vasile, under the scientific coordination of Prof. Univ. Dr.Vamanu Adrian, within the Doctoral School of USAMV Bucharest, comprises 3 parts structured on: 5 chapters, 33 figures, 19 tables, 3 annexes and bibliography with 116 titles (of which 18 electronic resources).

The first part of the PhD thesis is named "*Current state of research on the importance and realization of distillates from fermentable and non-fermentable raw materials*", **the second part** is named "*Personal research*", and **the third part** presents "*Final conclusions*".

In order to achieve the aim and objectives proposed in the doctoral thesis, **part I** was structured on 2 chapters. **The first chapter** „*General considerations on distillates*" includes a documentary study on distillates (brief history of distillation, general aspects of distillation, raw and auxiliary materials used in the manufacture of distillates and classification of distilled alcoholic beverages). **Chapter II** "*Current state of research on the achievement of distillates*" includes a documentary study on the fermentation of raw materials, distillation, rectification and distillation facilities (discontinuous distillation facilities and continuous distillation plants).

Based on the study of documentary a research plan was established, which includes:

- The determination of the antioxidant potential by means of *in vitro* methods (Total antioxidant activity and reducing power) of topinambour alcoholic beverages (*Helianthus tuberosus* L.);
- The determination of the antioxidant potential by *ex vivo* methods (inhibition of haemolysis in erythrocytes and lipid peroxidation inhibition) for topinambur alcoholic beverages;
- The determination of the cytotoxic effect on the HCT 8 cell line;
- The determination of total phenolic content and content of flavonoids in topinambur alcoholic beverages;
- The determination of polyphenolcarboxylic acids by high performance liquid chromatography (HPLC);
- Completion of the original distillation plant;

- Obtaining original natural distillates with the help of its own distillation plant.

Part II –*„OWN CONTRIBUTIONS"* includes the following chapters:

Chapter III named "*Working materials and methods*" includes 5 sub-chapters:

- „Presentation of the vegetable material taken into work" Where the raw and auxiliary materials used to obtain the topinambur extracts are described:
  - Topinambur Tubers (*Helianthus tuberosus* L.);
  - Apple (*Malus pumila* Miller);
  - Pears (*Pyrus communis*);
  - Cinnamon (*Cinnamomum verum* J.Presl);
  - Bitter gourd (*Momordica charantia* L.);
  - Berries;
  - Starch;
  - Dock (*Stevia rebaudiana* Bertoni).
- *"Analysis methods*" where it is presented how to obtain the topinambur extracts, the determination of the bioactive compounds, the *in vitro* determination of antioxidant activity (total antioxidant activity and reduction power), e*x vivo* tests (Inhibition of haemolysis in erythrocytes and lipid peroxidation inhibition), *in vitro* cytotoxicity test;
- "*Design of the original discontinuous distillation plant*" with two subheadings:
  - "Simple discontinuous distillation plant with mixer (simple still with mixer)";
  - "Discontinuous distillation plant with dephlegmator lid, dephlegmation disk and pre-heater – original concept".
- "*Technologies for obtaining distillates from fermentable and non-fermentable raw materials on the original plants*" with two subheadings:
  - "Protocol for the fermentation of non-fermentable raw materials containing starch";
  - "Protocol for the fermentation of non-fermentable raw materials containing inulin (*Helianthus tuberosus* L.- Topinambur)"
- *"*Original products obtained with an own distillation plant*"*with two subheadings:
  - The"Mystery of Plants" distillate which shows how to obtain an original distillate 47% vol. alcohol.

- ”Hypertonic Mystery of Plants” supplement, tonic and fortifying ingredient from hydroalcoholic herbal extracts from herbs, forest fruits and topinambur distillates.

Chapter IV named “Results and Discussions" includes six subchapters:

- “The *in –vitro* determination of the antioxidant activity”;
- “The *ex-vivo* antioxidant activity”;
- “The cytotoxic effect”;
- “Compounds with antioxidant effect”;
- “The design of the original discontinuous distillation plant”;
- “Original products obtained with own discontinuous distillation plant”.

Chapter V ”*Original contributions of the PhD Thesis”* presents the novelty of the thesis:

- Obtaining original distillation plants (simple still with mixer and discontinuous distillation plant with dephlegmator lid, dephlegmation disk and pre-heater – original concept) that increase the yield and quality of distillates;
- Technology of obtaining distillates from fermentable and non-fermentable raw materials on original plants: development of processes for obtaining topinambur distillates (*Helianthus tuberosus* L.).
- Original product formulation: Creation of the experimental product stage of the *Mystery of the Plant* distillate and the *Hypertonic Mystery of the Plant* supplement, by corroborating the technological, analytical results obtained in phytocomplex studies with immune-modulatory, anti-inflammatory and antioxidant, digestive, carminative and tonic effects.

Part III-a, named “*Final conclusions*”, presents the conclusions of the research carried out and recommendations on the prospects for further scientific approaches that may be undertaken.

The beverages analysed, based on a topinambur distillate, showed a significant biological activity consistent with the bioactive compounds content due to taste and flavour enhancing supplements. Berries from sample BF 6 (topinambur distilled, starch, berries and dock) and BF 8 (distilled topinambur, apple, berries and dock) showed biological activities highlighted by *in vitro* and *ex vivo* studies, mainly due to the content of polyphenol-carboxylic acids. The gallic acid, commonly found in biaxial extracts, was the least stable, being identified only in three of the formulas analysed. Instead, the caffeic acid was present in all samples,

although its value did not exceed 1 mg / 100 mL. The stability of the preparations was high over time, with no significant loss ($p < 0,05$), and the appearance was clear and constant.

Compared to other beverages containing a high amount of anthocyanin, topinambur distillate, starch, berries and dock and topinambur distillate, apple, berries and dock have a very low content of ascorbic acid, correlated with time stability. If it had been present, ascorbic acid would have caused loss of biological activity resulting from the degradation of the anthocyanin component. These results are correlated with a stability of the colour of the product, and the antioxidant activity is also directly influenced by the presence of these flavonoids in forest fruits along with tannins.

Such alcoholic beverages, containing naturally occurring bioactive compounds, sweetened with dock, can be consumed even by people suffering from diabetes. Cinnamon and berries mask the unpleasant taste of the dock, resulting in a formula with a high content of double active compounds, which makes target-groups have a normal way of life. These innovative formulas are not an encouragement of alcohol consumption but an attempt to show that a small volume of alcohol can have beneficial effects on the body through a high antioxidant intake due to the supply of valuable secondary metabolites.

Compared to the simple still, the one with the mixer - own concept - has a production capacity of 30-40% higher by faster distillation and the final product is of better quality, it is built with double walls and bottom, and the steam is introduced directly into the boiler through a bubbler.

Also, the still with a mixer can be heated not only with direct fire but also indirectly, through an oil, water or steam bath.

The discontinuous distillation plant with dephlegmator cap, dephlegmation disk and pre-heater for which 3 years of work were necessary has certain special features:

- The distillation is done slowly and fractionally to obtain a special flavour;
- Both raw materials with viscous consistency and liquids can be distilled;
- The originality of this plant is given by the combined dephlegmator made up of 3 sections: cylindrical dephlegmator, tubulardephlegmator and dephlegmator with deflection plates;
- The boiler is fed directly with steam into the raw material, which is an advantage that no more water should be added to the boron dilution;
- During distillation, the temperature can be easily controlled by increasing or decreasing the steam flow entering the raw material.

The “Mystery of Plants” herbal alcoholic beverage is a select product, obtained from carefully selected ingredients, in order to capitalize on the biologically active principles and to create a special flavour. For the harmonious blending of sanogenic properties with a unique taste, “Mystery of the Plants” is the result of a complex process of slow and fractional distillation with the help of an original plant, unique in Romania, followed by the maturing for 3 years in new oak barrels. Particular attention paid to the process of production and maturation, it aims to valorise as much as possible the sanogenic principles contained by the medicinal plants used without compromising the taste of the product.

The sanogenic qualities of distillate “Mystery of the Plants” are supported by laboratory analysis and scientific research carried out over a 3 years’ period. Thus, the product is proven to have an antioxidant, anti-inflammatory, immune-modulatory, digestive, carminative and tonic effect due to the active principles contained in the laboratory's top laboratories in our country.

With the synergy of flavonoids, polyphenolcarboxylic acids and volatile oils contained, the herbal alcoholic herb “Mystery of Plants” manages to harmoniously combine a unique, pleasant taste with exceptional sanogenic properties.

The complex formula of the product “Hypertonic Mystery of Plants” has been specially designed to create complementarity and synergy of the natural active compounds contained in the forest fruits with those of the 30 herbs.

The product “Hypertonic Mystery of Plants” is recommended for general body toning and revitalization, natural immunity strengthening, gastrointestinal, renal and perspiration inducing elimination of toxins in the body, stimulation of physical and intellectual activity for both students and adults, and for toning and regulating vital functions for the elderly. These properties are explained by the high content of vitamins, minerals and other bioactive compounds, forest fruits and medicinal plants, which are kept unaltered, with increased bio-availability due to minimal processing of the ingredients without thermal treatments (cold pressing to obtain berry syrups and maceration to produce bitter).

In order to accelerate the aging process of distillates we developed an original method by bubbling the contents of the active oxygen barrel onto a crank driven by a tiller-crank. Certain flavours are intensified and taste is rounded. It is achieved an aging of the product about 10 times faster than in the classical version.