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The Potential of Agro-homeopathy Applied to Medicinal Plants —A Review

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Abstract

The homeopathic preparations can influence the growth, secondary metabolites production, essential oil yield and phytochemical profile when applied in the grown of medicinal plants. To compile this review articles from existing literature about basic research related to the use of homeopathic preparation on the cultivation of medicinal plants and its influence on the phytochemical profile, growth, yield and composition of essential oil were collected. The bibliographic research was carried out in scientific databases sites—Scopus, Web of Science and PubMed. Seventeen publications were found in which homeopathy was applied in the cultivation of medicinal plants. Its use changed the phytochemical profile, increased the essential oil yield, the production of secondary metabolites (coumarins, alkaloids, phenylpropanoids), the the nutrients absorption and the growth of the medicinal plant species were studied. This review shows that the application of homeopathic preparations in the cultivation of medicinal plants increases the production of secondary metabolites and essential oils that are important for human and animal health therapeutic treatments.The homeopathic preparation application is an alternative for the growth of medicinal plants with ecological balance, and without soil and water contamination. It is also affordable to farmers and researchers. However, further studies are required on its influence on the phytochemical profile of the cultivated medicinal species.

Keywords: agroecology, homeopathy, *in vivo,* secondary metabolites

1. Introduction

Medicinal plants are important for health maintenance; it is considered the most affordable therapeutic treatment used by 80% of the population (Moreira, 2010). The cultivation of medicinal plants need to be based on agroecological agriculture, without the use of synthetic chemical products that contaminate soil, environment and the plants with therapeutic purposes (Willer et al., 2010; Santos et al., 2014).

Therefore, there is an increase in the number of farmers and researchers seeking for natural and ecological alternatives aiming to obtain medicinal plants free of chemical residues (Brasil, 2011; Moreno, 2017). Besides improvement in growth, there is also increase of secondary metabolites production, essential oil and phytochemicals with pharmacological and biological interest (Moura et al., 2017; Nunes et al., 2018).

The use of homeopathy in agriculture has been changing conventional agriculture to agroecological (Andrade et al., 2011), through the application of homeopathic preparations in different dynamization, following the Homeopathic Pharmacopoeia guidelines proposed by Hahnemann in 1810 (Hahnemann, 2013). The homeopathic dynamizations follow the principles of disintegration of matter and radiation without nuclear rupture, through the mechanical action on the smaller particles and addition of inert substances with dynamic activity, following the laws of electromagnetic waves: frequency, length and amplitude (Bonato, 2008).

Homeopathic preparations can be applied on the soil and/or on the leaves (Santos et al., 2011; Andrade et al., 2012). These preparations can increase or decrease the production of bioactive substances due to its influence on the primary and secondary metabolism of medicinal plants modifying its phytochemical profile (Capra et al., 2014; Verdi et al., 2016). The application of nosodes and biotherapeutics are the most applied techniques in agro-homeopathy (Jãger et al., 2010; Moreno et al., 2018).

The present review aims to compile the basic homeopathy research existing in the literature applied to the cultivation of medicinal plants and to verify its influence on the plant growth, phytochemical profile, yield and composition of the essential oils.

2. Methods

The bibliographical research was accomplished by compiling the publications from the databases Scopus, Web of Science and PubMed that evaluated the application of the homeopathic preparations in the growth of medicinal plants. To carry out this research, different key words related to this subject were used, such as medicinal plants + homeopathy + cultivation + secondary metabolism, soil, essential oil. All the objectives, results and conclusions sections of the papers found were analysed for the writing of this review.

Scientific articles, term paper, master's degree dissertation and doctoral thesis that researched the application of homeopathic preparation in the soil, leaves pulverization and evaluated its influence on the growth, essential oil yield and phytochemical profile were included in this review.

3. Results

Seventeen studies carried out between 2002 and 2016 were found in the search. They evaluated the influence of homeopathic preparation in the cultivation, essential oil yield and phytochemical profile of 11 medicinal species (Table 1). They analysed nineteen homeopathic preparations in different dynamizations, being *Phosphorus, Sulfur and Silicea* the most studied ones (Almeida, 2002; Castro, 2002a, 2002b, 2003; Duarte, 2007; Bonato et al., 2009; Gonçalvez, 2010; Santos et al., 2011; Capra et al., 2014; Verdi et al., 2016).

Table 1. Abstract of medicinal plants species elicited by boosted homeopathics

Scientific Name	Application via	Source/Treatment	Evaluation	Pharma-cogenetic	Efficient treatment	Results	Authors
Ocimum basilicum L.	Soil	Arsenicum album, Carbo vegetabilis, Calcarea carbonica, Phosphorus, Sulphur, Silicea and Cuprum (30ch)	Essential oil	Leaf	Phosphorus 30cH	*Sulphur 30cH* (52.73%), *Calcarea carbonica 30cH* (47.37%) and *Carbo vegetabilis 30cH* (27.27%): < Essential oil; *Phosphorus 30cH*: > Essential oil (130%)	Almeida (2002)
Cymbopogon citratus L.	Soil and leaf	Humic acid, isoterapic and Sulphur (3c, 12c, 30c, 200c, 1000c), control	Essential oil, concentrations of neral, geranial and citral	Leaf	Sulphur and Isoterápico 12c	*Humic acid 12c and Sulphur 12c*: > Rates of the neral and geraniol; *Sulphur 30c*: > Rates of the neral; *Isoterapic 12c*: > Bioomass and essential oil	Castro (2002)
Justicia pectoralis Jacq.	Soil and leaf	Humic acid, isoterapic and Sulphur (3c, 12c, 30c, 200c, 1000c), control	Methanolic extract and coumarin content	Leaf	Sulphur and Isoterápico 200c	*Sulphur 30c*: > rates of the methanolic extract; *Humic acid 12c, 30c and 200c*: > Coumarin content; *Humic acid 200c*: > Coumarin in (353%)	Castro (2002)
Ageratum conyzoides L.	Soil	*Ageratum conyzoides* L. (2c, 4c, 6c, 30c, 60c, 200c) and control (root, shoot and whole plant)	Growth, essential oil and coumarin content	Leaf	*Ageratum conyzoides* L. 2c, 6c, 30c	*Ageratum conyzoides L. 30c and 4c whole plant*: < Essential oil; *Ageratum conyzoides L. 2c whole plant*: > Essential oil (62%); *Ageratum conyzoides L. 6c and 30c root*: > Coumarin contente	Duarte (2003)
Cymbopogon citratus L.	Soil	Humic acid (AH), isoterapic *Cymbopogon citratus* L. (ISO) and Sulphur (S) (3c, 12c, 30c, 200c, 1000c)	Essential oil	Leaf	*Cymbopogon citratus* L. 6c and 12c	*Cymbopogon citratus L. 6c and 12c*: positive effect; *Cymbopogon citratus L. 200c*: negative effect	Castro et al. (2003)
Tanacetum parthenium L.	Soil	Arnica montana (1dH, 2dH, dH3, 4dH and 5dH)	Fresh biomass and parthenolide content	Leaf	Arnica montana (1dH, 2dH, 4dH and 5dH)	> Plant height < Parthenolide content	Carvalho et al. (2003)

Bidens pilosa L.	Soil	Alumina 3cH, Nitricum acidum, Natrum muriaticum, Calcarea carbonica, Calcarea phosphorica, Sulphur, China, Magnesia carbonica and controls 70% ethanol and distilled water and China (2c, 4c, 8c, 10c, 12c, 14c, 16c, 18c, 20c, 22c, and 24c)	Morphological response, essential oil content, catalase and peroxidase enzymatic activity, production of antimalarial compounds	Leaf	China 3cH	*China 3cH*: > Fresh biomass Enzymatic activity of peroxidase and catalase was not influenced by homeopathic preparations	Armond et al. (2003)
Tanacetum parthenium (L.) Schultz-Bip	Soil	Natrum muriaticum (2cH)	Proline	Leaf	Natrum muriaticum 2cH	> Chlorophyll and proline levels	Carvalho et al. (2004)
Bidens pilosa L.	Soil	Solutions from China	Growth, flavanoid levels, acetylene and essential oils	-	Solutions from China	Changes on the phitochemical spectrum	Armond et al. (2005)
Tanacetum parthenium (L.) Schultz-Bip	Soil	Arnica montana	Partenolides	Dry aerial part	Arnica montana	Height and fresh mass haven't been modified cause of the solutions < Partenolide levels 3cH and 5cH	Carvalho et al. (2005).
Eucalyptus citriodora & Eucalyptus globulus	Soil	Phosphorus (3cH, 6cH, 12cH, 30cH, 100cH, 200cH, 1000cH and 5000cH)	Growth and essential oil	Leaf	Phosphorus 12cH	> Essential oil	Duarte (2007)
Mentha arvensis L.	Soil	Sulphur (3cH, 5cH) and Arsenicum (3cH)	Essential oil	Dry leaves	Arsenicum 3cH	Sulfur Boosted > Essential oil levels 34% and 21% Arsenium > Oil rates in 45 and 21%, for 24 and 30cH > Photosynthetic rates	Bonato et al. (2009)
Talinum triangulare (Jacq.) Willd (Portulacaceae)	Soil	Phosphorus (3cH, 6cH, 12cH, 30cH, 100cH) and control (energized water)	Production of flavanoids and antioxidant capacity of the plant extract	Leaf	Phosphorus 3cH, 12cH and 30cH	> Content of flavonoids > Antioxidant activity	Gonçalvez (2010)
Verbena gratissima	Soil	Phosphorus (9cH)	Growth and essential oil	Leaf	Phosphorus 9cH	> Growth, fresh biomass. influenced the composition of the essential oil with increase of beta-pinene acetate, trans-pinocarveol, trans-pinocamphone and trans-pinocarvyl acetate	Santos et al. (2011)
Justicia pectoralis Jacq.	Pulverization	Justicia	Morphologic features, coumarin levels, eletromagnetic field	Leaf	Justicia	Justicia, Arnica montana, Phosphorus > Coumarin levels 54.35%; Humic Acid > 55.10% Justicia	Andrade et al. (2012)
Baccharis trimera (Less.) DC.	Pulverization Leaf	Silicea (cH6, cH12, cH30, 7dH), Equisetum (7dH) and control	Fresh and dry biomass, quercetin content	Leaf	Silicea cH6, 7dH and Equisetum 7dH	*Silicea cH6 and 7dH*: > Quercetina contente 30% and 47%, respectively; *Equisetum 7dH*: > Quercetina content (45%)	Capra et al. (2014)
Ocimum basilicum L.	Pulverization Leaf	Silicea (7cH, 12cH, 30cH) and Equisetum (12cH, 14cH, 16 cH) and distilled water	Essential oil	Leaf	Silicea 30cH	> Essential oil yield 141%	Verdi et al. (2016)

The researchers observed that homeopathic preparations can improve the photosynthetic rates through changes in the physiological mechanisms, as the allocation of greater levels of photo-assimilated compounds in the leaves boosted growth (Bonato et al., 2009; Andrade, 2012).

The homeopathic application of *Natrum muriaticum 2cH* via soil increased the content of chlorophyll in the leaves of *Tanacetum parthenium*; it also increased the photosynthetic rates and the biomass production (Carvalho, 2004). The same homeopathic preparation applied during the cultivation of *Mentha arvensis* (Carvalho, 2004) changed the photosynthetic rates of this species. These results can be related to the higher number of chlorophyll molecules that increases the capacity of light absorption and induces rubisco activity, leading to higher carbon absorption. This increases the synthesis of fundamental compounds for the secondary metabolism, which are responsible for the production of bioactive molecules with therapeutic properties.

According to Ramzam (2015) the synthesis of glucose molecule through physiological processes (photosynthesis and respiration) produces organic compounds (sucrose). In addition to providing energy for plant growth and development they also act on the precursors of shikimic acid and acetate. These precursors form the mevalonate (MEV) and *1-Deoxy-D-xylulose 5-phosphate* (DXP) pathways. These pathways are the origin of some secondary metabolism categories such as flavonoids, tannins, alkaloids, phenolic compounds, terpenoids and others.

Biotic and abiotic factors are related to plant growth, the physiology and biochemical plants response (Capra, 2014). Changes in the environmental conditions in response to the application of homeopathic preparations can redirect metabolic pathways with influence on the production of secondary metabolites, fresh and dry biomass production, yield and chemical composition of the essential oils in medicinal plants (Carvaho, 2004; Bonato, 2009; Andrade, 2012; Capra, 2014; Verdi, 2016).

Application of *Justicia Isotherapic* increased coumarin content on the leaves and stem of *Justicia pectoralis* Jacq. This result reaffirms that at the principle of similitude there is a response from the plants vital energy that canalize its energy for the production of secondary metabolites with pharmacologic activity (Andrade, 2012) such as antioxidant, antiasthmatic, (Cameron et al., 2015; Moura et al., 2017), anti-inflammatory (Nunes et al., 2018).

The application of homeopathic preparations on the soil and/or on the leaves can change the phytochemical profile of medicinal species (Castro, 2002b; Duarte, 2003; Armond et al., 2005; Gonçalvez, 2010; Santos et al., 2011; Andrade et al., 2012; Capra et al., 2014) and it can increase the essential oil yield (Almeida, 2002; Castro, 2002a; Duarte, 2003; Duarte, 2007; Bonato et al., 2009; Verdi, 2016). On the other hand, Carvalho et al. (2003) and Armond et al. (2003) observed a reduction in the production of secondary metabolites and no influence in the peroxidase and catalase enzymatic production when homeopathic preparation was applied on the species *Tanacetum parthenium* L. and *Bidens pilosa* L, respectively.

Homeopathic preparation affected the chromatographic profile of the essential oil of *Bidens pilosa* L. (Armond, 2005) showing distinctive peaks of organic acids like chlorogenic acid, acetylenes, flavonoids, which are bioactive molecules with antimalarial function. Therefore, the efficiency of the homeopathy to change the phytochemical spectrum, and to increase the yield of essential oils in plants used as medicine for humans health is of great social and economic importance.

Ten out of seventeen studies on this work showed changes in the phytochemical profile of the medicinal plants as a function of homeopathic preparations. Castro (2002a) in applying *Sulphur* and *isotherapeutic 12c* observed an alteration in the phytochemical profile of *Cymbopogon citratus* L. with an increase of neral and geraniol content. These compounds are used in the traditional medicine due to its antispasmodic and analgesics activity (Sadraei et al., 2015).

According to Castro (2002b) and Duarte (2003) the application of homeopathic preparations—*Sulphur*, *Humic Acid 200c* and *Ageratum conyzoides* L. *2c*, *6c*, *30c*—in different dynamizations during the grown of *Justicia pectoralis* Jacq. and *Ageratum conyzoides* L. increased over 353% the coumarin content when compared to the control treatment. Evidences have shown that coumarin presents anti-inflammatory, antinociceptive, antispasmodics, muscle relaxant and anxiolytic properties, with great potential on the development of phytoterapics (Leal et al., 2017).

The application of *Phosphorus* via soil in dynamizations (*3cH*, *12cH* and *30cH*) increased the levels of flavonoids responsible for antioxidant activity of the plants *Talinum triangulare* (Jacq.) Willd (Portulacaceae) (Gonçalvez, 2010; Liao et al., 2015). *Phosphorus* in the dynamization 9 cG enhanced the production of beta-pineno acetatus, trans-pinocarveol, trans-pinocamphone and trans-pinocarvyl molecules in plants of *Verbena gratissima* therapeutically used due to its antimicrobial property (Santos et al., 2011). Capra et al. (2014) verified an increase of 30% and 47% in the content of quercetin in response to the application of *Silicea 6cH*, *7dH* and *Equisetum 7dH*, respectively, in the *Baccharis trimera* cultivation. This compound is widely employed in the treatment of liver diseases, diabetes and digestive disorders (Pádua et al., 2010).

However, negative effects were also found by the researches Carvalho et al. (2003) and Carvalho et al. (2005). The use of *Arnica montana* in 5 dynamizations and and *Natrum muriaticum 2cH* in the cultivation of *Tanacetum parthenium* (L.) Schultz-Bip decreased the partenolidium content, an active principle that acts in carcinogenic cells.

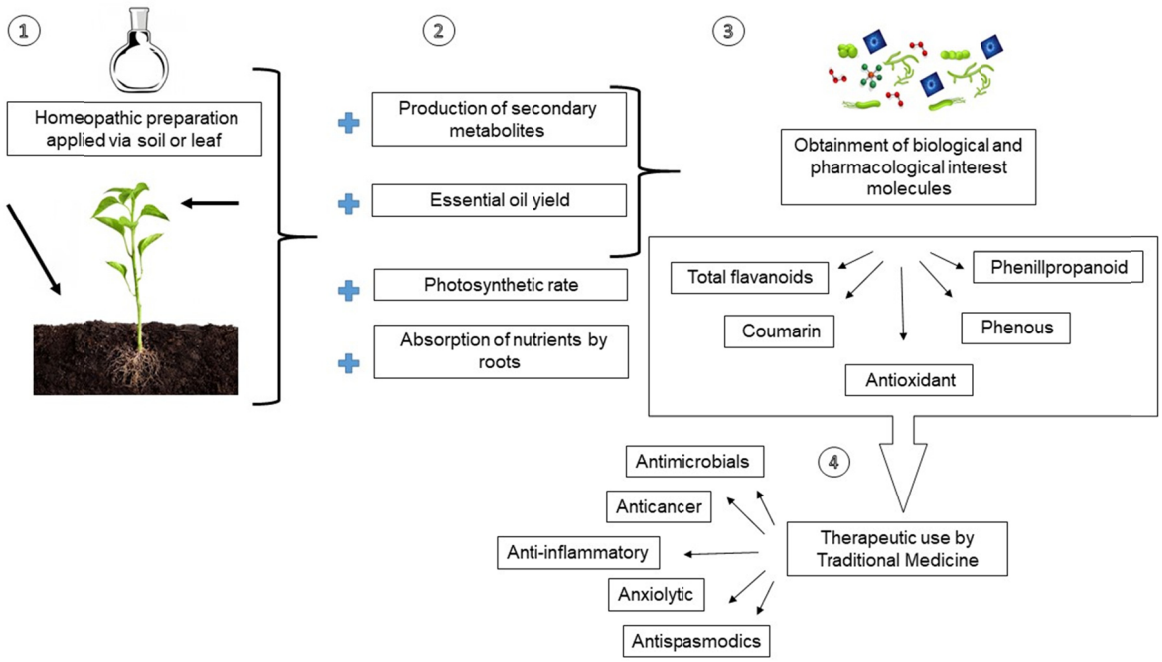

Figure 1. Benefits of the application of homeopathic preparations in the cultivation of medicinal plants

4. Final Considerations

The homeopathic preparations applied on the soil or on the leaf during the cultivation of medicinal plants changed the phytochemical spectrum, increased the essential oil production and yield, photosynthesis rates and the potential for the production of active principles with pharmacological and biological properties. Those compounds have therapeutic use such as antioxidants, anticancer, antispasmodics, and antimicrobials among others properties. Research approaching the use of homeopathy in the cultivation of medicinal plants is highly relevant for being a lifelong practice that aims at not only the optimization of production but also the quality of chemical constituents. Besides being an accessible practice to farmers, it contributes to the strengthening of agroecology and the expansion of the productivity chain of medicinal plants. However, further studies are needed to understand the influence of the application of homeopathic preparation in the cultivation of medicinal plants and how it affects the production of secondary metabolites and essential oil.

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