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A COMPREHENSIVE REVIEW ABOUT ANTIMICROBIAL EFFECTS OF HERB AND OIL OREGANO (*ORIGANUM VULGARE* SSP. HIRTUM*)*

CHIȘ Maria-Simona, Sevastița MUSTE*, Adriana PĂUCEAN, Simona MAN, Alina STURZA, Georgiana Smaranda PETRUȚ, Andruța MUREȘAN

University of Agricultural Sciences and Veterinary Medicine,
Faculty of Food Science and Technology Food Engineering Department,
3-5 Mănăstur Street, 3400, Cluj-Napoca, Romania;
*Corresponding author, e-mail: sevastita.muste@usamvcluj.ro

Abstract: In the last decades, consumers' attention has been focused on natural food products without preservatives, because they believe that food could have a direct influence on their health. From the industrial point of view, these new consumers' preferences involves technological changes and reorientation to natural raw materials, like plants. In order to reduce or remove the synthetic preservatives from food products, previous researches has emphasized on the importance of self-life prolongation by using natural products like oregano (*Origanum vulgare, Hirtum ssp.*) herb and oil. The following mini-review attempts to synthesize the importance of oregano in food preservation industry due to its rich chemical composition on bioactive compounds which could have antimicrobial effects.

Keywords: Origanum vulgare, Hirtum* ssp., *essential oil, antimicrobial effect, self-life.

Introduction

Plants have an important role in human health and can be used in various areas like: medicine, cosmetic, domestic consumption and food industry. According to World Health Organization, 80% of the inhabitants believe in folk medicine as the first health care needs, which mainly involves the bioactive compounds from plants extracts (Ertas *et al,* 2005). Essential oils are obtained from plants and characterized as aromatic and volatile oily liquids rich in biologically active compounds like phenolic

acids and terpenoids, with antibacterial and antifungal activities (Hosseini *et al.*, 2013). This plants extracts, especially essential oils are Generally Recognized as Safe (GRAS) (Zinoviadou *et al*, 2009).

Essentials oils have been used for thousands of years as antimicrobial agents. The consumers' preferences demand for products with natural preservatives but safe and with self-life prolongation, with reduction of salt and sugar for dietary reasons. These new preferences encourage the use of aromatic plants thanks to the health benefits, low sodium content and low calories (Dadalioglu *et al*, 2004). In order to obtain this aim, the researchers tried to develop natural and safe products, using herbs and essentials oils.

Botanical description and bioactive constituents

In the spice market are common two kinds of oregano: European and Mexican one. European oregano is derived from *Labiateae* family, while Mexican oregano is part of the *Verbenaceae* family. The European oregano has a superior quality that the Mexican one, having on the world market a price almost three times higher (Fleisher *et al*, 1982).

Oreganum species grow on rocky mountain and stony slopes, at an altitude of 0-4000 m and are used in pharmaceutical and cosmetic industries, in agriculture, as a culinary herb, alcoholic beverages and perfumery (Sahin *et al.*, 2004).The most commonly found oregano species belong to the botanical family *Labiateae*, genus *Origanum* and it has a local distribution around the Mediterranean, according to (Doğan *et al*, 2005) and (Govaris *et al*, 2010). To the genus *Origanum*, belong forty-nine taxa, *Origanum vulgare*, *Hirtum* ssp. having the largest distribution between *Origanum* species (Jerkovic, etal. 2001). For the demand and acreage point of views, oregano is the most important aromatic plant species in Argentina, and it is mainly used for domestic consumption, industry and for exportation (Torres *et al.*, 2010).

Oregano name could be translate as „delight of the mountains" and derives from greek roots „horos" and „ganos"(Calpouzos, 1954).

Oregano is an annual, perennial and aromatic plantwich has been used in medicine for thousands of years (Ertas *et al.*, 2005). The leaves, dried herbs and volatile oil are very popular in Mediterranean countries and are widely used in South European cuisine (Chun *et al.*, 2005).

In folk medicine *Origanum vulgare* is used to treat different disorders like: painful menstruation, respiratory and urinary tract disorders, dyspepsia and scrofulosis (Teixeira *et al.*, 2013).

Dyspepsia is linked to *Helicobacter pylori*, which is able to survive in the stomach and it is responsible for peptic ulcer. A new treatment with oregano and cranberry extract mixture provide a natural and dietary solution for this gram-negative bacteria (Lin *et al.*, 2005).

Carvacrol, thymol and their precursors, γ-terpinene and p-cymene, are primary components of oregano essential oil which has antibacterial and antifungal effects (Rodríguez-Meizoso *et al.*, 2006) (Simitzis *et al.*, 2008). This primary components could be present in different proportions depending on the species, on the climate and growing conditions (Ávila Sosa Sánchez *et al.*, 2015).

The monoterpene phenols: thymol and carvacrol, together with γ-terpinene and p-cymene are the main components in many essential oils of *Laminaceae* family plant. Thymol and carvacrol are biosynthesized by aromatization of γ-terpinene to p-cymene followed by hydroxylation of p-cymene (Nhu-Trang *et al*, 2006).

As a medicinal plant, oregano is used due to the antimicrobial, anticoccidial, antifungal, antispazmolytic and antioxidant effects (Ertas *et al.*, 2005). Also it is used in treatments of menstrual problems, as a traditional remedy for ailments like spasmodic and digestive problems or as a treatment of infectious diseases (Sahin *et al.*, 2004).

Oregano dried leaves and flowers are rich in volatile aglycones like benzyl alcohol, eugenol, 2-phenyl-ethanol, thymol, 3-hexen-1-ol and carvacrol, thymoquinone being the major component. The volatile aglyconesin the spice plant oregano were found to be potent antioxidants, comparable in activity with its essential oil (Milos *et al*, 2000).

From the leaves of *Origanum vulgare* have been isolated five different phenolic compounds: protocatechuic acid, caffeic acid, rosmarinic acid, a phenyl glycoside and 2-caffeoyloxy-3-[2-(4-hydroxybenzyl)-4,5-dihydroxyphenyl]propionic acid, with antioxidant activity (Pizzale *et al.*, 2002).

The oregano oil, used traditionally for their aromatic properties especially in the Mediterranean cuisine, have good properties as free radical-scavengers/antioxidants, according to (Tomaino *et al.*, 2005).

Oregano is also very rich in minerals like: Ca (1043mg/kg), Fe (159mg/kg), K (19625 mg/kg), Cr (7.43 mg/kg), Ba (79.8 mg/kg)

which are important structural components of tissues with cellular function and could influence the water and acid-base balance, as reported by (Özcan, 2004).

Antimicrobial effects of oil and herb oregano

One of the most important uses of oregano oil and herb is in the food industry. Due to the chemical composition, oregano help to improve the shelf-life, nutritional qualities of many products like bread and bakery, meat, cereals and also it could be successfully used in animal diet in order to improve meat quality.

The shelf life of bakery products stored at room temperature is limited at 3-4 days and it is influenced by the microbial spoilage like molds mainly due by *Penicillium sp.* and other fungi (*Aspergillus, Monilia, Mucor, Endomyces, Cladosporium, Fusarium* or *Rhizopus* genera).

To avoid the appearance of microbial spoilage on the bakery products numerous alternatives are being applied: irradiation, addition of propionic, benzoic and sorbic acids in modified atmosphere packaging and ethanol incorporated into the packaging material. All this synthetic preservatives may be perceived by consumers and had negative effect on the quality of the final product and on the consumers' health.

Oregano herb is rich in crude fiber, antioxidant activity, total phenols content and it can be used up to 2% level in bread to improve nutritional and sensorial qualities, specific bread volume and bread shelf life, having inhibitory action again molds (G K et al, 2013). Also, the natural antimicrobial compounds from oregano could influence the preservation of bread and other bakery products, being antimicrobial agents against fungal growth in many foods (Ávila Sosa Sánchez *et al.*, 2015). Oregano herb could successfully be used in producing graham bread, as reported by (Muresan *et al.*, 2012).

Nowadays, sachet is a innovative system containing different concentrations of oregano essential oil that could have antimicrobial effect for sliced bread preservation controlling *Penicillium sp*. and fungal spoilage (Passarinho *et al.*, 2014).

Oregano *(Origanum vulgare*) essential oil is added into edible films in order to prolong the shelf-life of sliced bread and bakery

products, due to the antimicrobial activity against some foodborne pathogenic and spoilage microorganism (Otoni *et al.*, 2014). Also, vapor-phrase technique with essential oil like oregano has an antimicrobial effect and help to improves the shelf-life products (López *et al.*, 2007).

Oregano oil is an essential oil which can be used against *Aspergilus niger*, being stronger that the rosemary or sage oil. A possible modes of antimicrobial action of phenolic compounds could be explained by the denaturation of enzymes responsible for spore germination or by the interfering with amino acids which have role in germination (Martos et al, 2006).

One of the main factors with influence on the food product preservation is the oxidative degradation of lipids which leads to toxic compounds and undesirable organoleptic changes. In order to replace the synthetic antioxidants like butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), which are considered as promotors of carcinogenesis, the interest in the use on natural antioxidants is increasing more and more (Pizzale *et al.*, 2002), (Milos, Mastelic and Jerkovic, 2000). The oregano extracts have effects in all the stages of the peroxidative process by the neutralization of free radicals, by blocking peroxidation catalysis, and by interruption of lipid radical chain reactions (Cittera *et al.*, 2000).

Using oregano essential oil (0.1%) with modified atmosphere packaging (30% CO2/70% N2 and 70% CO2/30% N2) improved shelf-like of fresh chicken meat stored at 4°C with 5-6 days, according to (Chouliara *et al.*, 2007).

Oregano oil it is also useful in refrigerate fish storage, being used as a natural preservative but also like an spice with pleasant flavor. Using 0.4% oregano oil in combination with modified atmosphere packaging (MAP) and light salting extended the shelf-life of sea bream *(Sparus aurata)* fillets with 17 days (Goulas et al, 2007).

Oregano *(Origanum vulgare L.),* clove *(Syzgium aromaticum)* and anise *(Pimpinella anisum L.)* oils mixed in different portions could be used in broiler nutrition as a potential natural growth promoter for poultry (Ertas *et al.*, 2005).

The oregano essential oil could be used as supplementation on a lamb diet, improving the antioxidant activity which had influence on retarding the lipid meat oxidation during refrigerated and long-term

frozen storage. This process could be explained by carvacrol and thymol action on the permeability off cell membrane and by the transformation of lipid and hydroxyl radicals into stable products (Simitzis *et al.*, 2008).

In order to ameliorate the negative stress effect on meat quality characteristics, a chicken's diet supplemented with oregano (3%), ascorbic acid and α-tocopherol has been used. The results showed improvements on the oxidative stability of lipids from pectoralis major and protection against stress-induced in different muscles (Young *et al.*, 2003).

Ethanoic oregano extracts contain high concentrations of phenols, mainly rosmarinic acid which has effect on the prevention of color deterioration of pork batter (Hernández-Hernández *et al.*, 2009).

The supplementation of turkey diet with oregano essential oil reduced lipid oxidation in raw and cooked turkey meat during refrigerated storage (Botsoglou *et al.*, 2003)

Also, oregano oil in combination with nisin, a polypeptide bacteriocin, showed antimicrobial activity against *Salmonella enteritidis* at minced sheep meat during refrigerated storage (Govaris *et al.*, 2010).

Oregano oil is very active against molds especially aflatoxigenic strains and foodborne bacteria like *Aspergillus niger, Aspergillus flavus, Aspergillus ochraceus, Staphylococcus aureus, Salmonella typhimurium, Campylohacter jejuni* and *Clostridiurn sporogenes* (Paster *et al.*, 1990).

Due to the hydroxyl group present in the structure of phenolic compounds from oregano oil, carvacrol is one of the most active plants extract against pathogens being used in antimicrobial active films in order to increased fresh beef s shelf life (Zinoviadou *et al*, 2009).

Oregano oil could be also used in order to prevent the infection of maize by *Fusarium spp.*, due to the presence of an aromatic nucleus and a phenolic OH group. The OH group can form hydrogen bonds with active sites of target enzymes (Velluti *et al.*, 2003). Oregano oil expert bactericidal effect due to the chemical composition rich in phenolic compounds which may cause damage in bacterial envelope with an important role in the life bacteria (Rhayour *et al.*, 2003).

Conclusions

To sum it up, it can be concluded that *Origanum vulgare, Hirtum ssp.* it is not only a aromatic plant that could be used in food consumption, medicine and pharmaceutical industry, but it may be also successfully used in meat, bakery and pastry industries in order to prolong shelf-life products as a natural preservative. Due to the rich chemical composition in antioxidants and phenols (thymol and carvacrol, together with γ-terpinene and p-cymene), oregano could influence the lipids oxidative degradation and may have antimicrobial effect. It can be used in edible films, sachet, modified atmosphere packaging, vapor-phrase technique in order to prolong shelf-life products.

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