USE OF NATURAL ANTIOXIDANTS IN MEAT AND MEAT PRODUCTS

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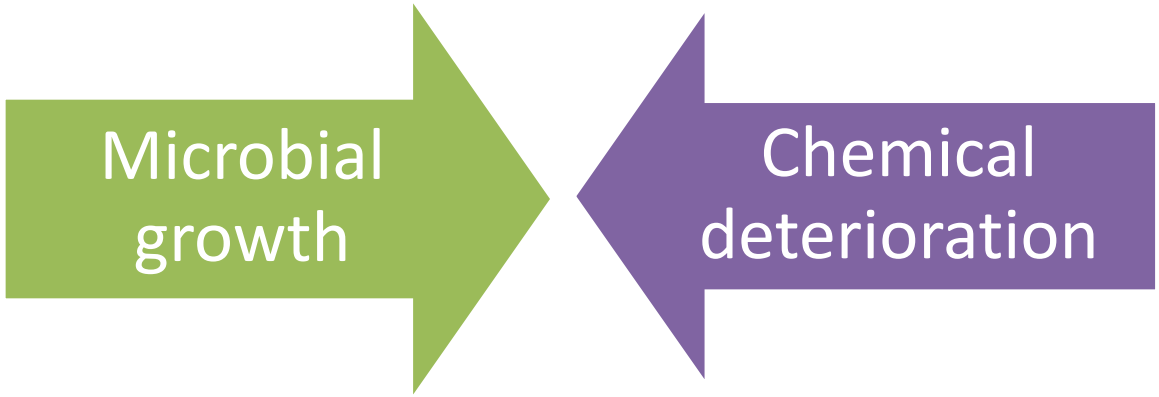
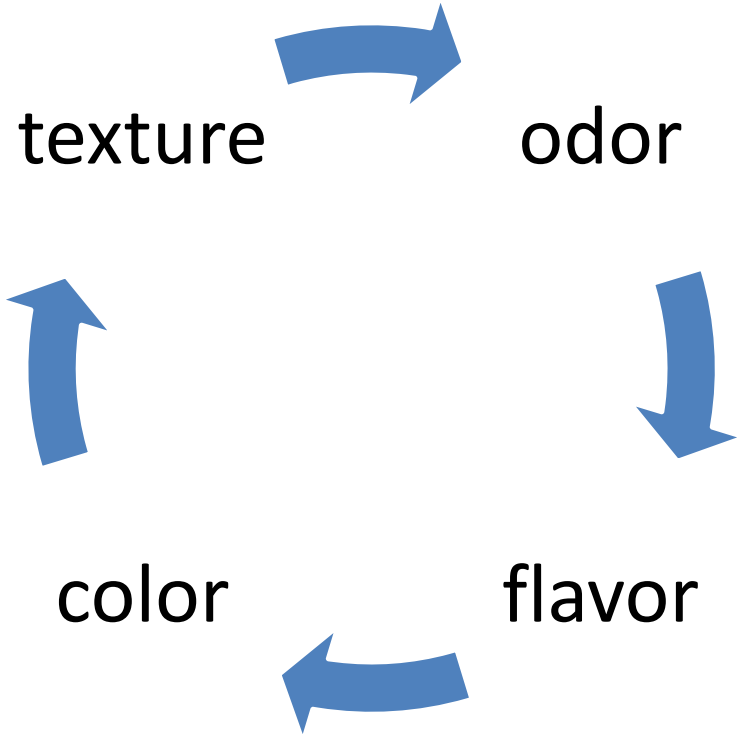
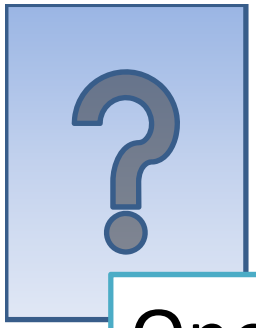
- Meat products typically spoil due to one of the two major causes;



- The most common form of chemical deterioration is oxidative rancidity (Kanner, 1994).

Lipid oxidation can have negative effects on the quality of meat and meat products causing changes in sensory attributes (color, texture, odor, and flavor) and nutritional quality.

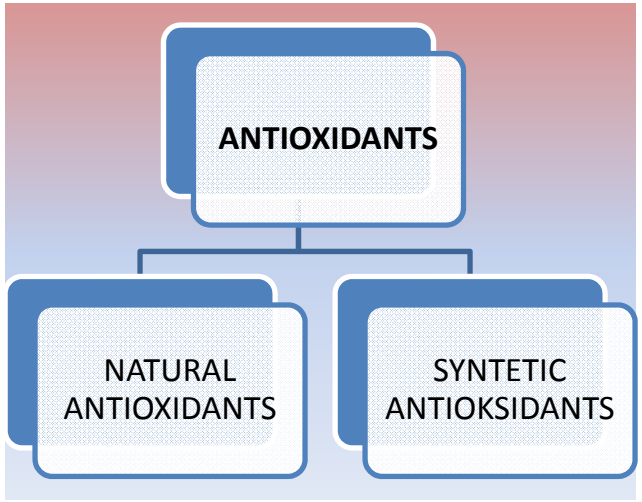




One method to reduce lipid oxidation is the application of antioxidants. Antioxidants are the chemical substances that reduce or prevent oxidation and have the ability to counteract the damaging effects of free radicals in tissues and thus are believed to protect against cancer, arteriosclerosis, heart disease and several other diseases

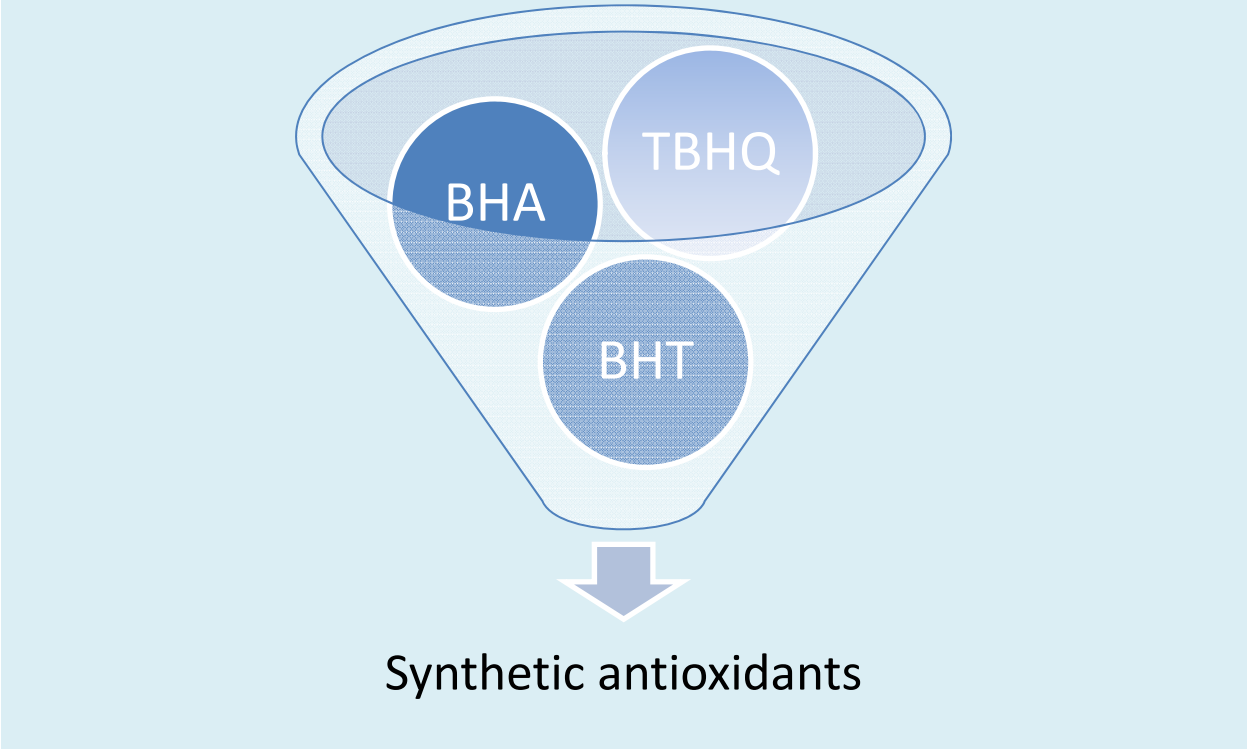
Types of Antioxidants

Antioxidants are a means of minimizing lipid oxidation. Antioxidants can act as metal chelators and free radical or oxygen scavengers which can slow the progression of lipid oxidation.



Synthetic and natural antioxidants have been successfully used to block or delay the oxidation process in meats (Cross *et al*., 1987).

The most common synthetic antioxidants used in the food industry are;



- Compounds obtained from natural sources such as oilseeds, spices, fruit and vegetables have been investigated to decrease the lipid oxidation.

3. Sources of Natural Antioxidants

3.1. Herbs, Spices and Teas

Herbs and spices have been used for many centuries to improve the sensory characteristics and to extend the shelf-life of foods.

- **Rosemary (*Rosmarinus officinalis L.*)** is popular herbs belonging to the Lamiaceae family with a verified potent antioxidant activity.
- The antioxidant activity of rosemary (*Rosmarinus officinalis*) has been known for about 30 years, and the active compounds have been identified.

- The main active substance is carnosol; and the active diphenolic diterpenes epirosmanol and isorosmanol have also been isolated from rosemary leaves.
- Rosemary extracts are available in water-soluble, oil-soluble and powdered forms. For use in fermented sausages, such as salami, the powdered form is recommended, mixed with spices for better distribution, since it is added in minimal amounts.

- Ho *et al*., (1995) stated that rosemary extract contained many compounds with antioxidant properties. These compounds probably function as free radical scavengers, thus reducing lipid oxidation.

Barbut *et al.,* (1985) reported that the addition of rosemary in refrigerated turkey sausage was an effective way to suppress lipid oxidation and to increase the shelf life.

Murphy *et al.,* (1998) observed that TBARS values were higher than the products without rosemary during frozen storage. Because of the purported health benefits of these highly effective natural antioxidant extracts, their application in the meat industry may be very valuable and desirable.

- **Sage *(Salvia officinalis)*** is a common aromatic and medicinal plant native from mediterranean countries that is in widespread use.

- Sage has been used in folk medicines for the treatment of all kinds of ailments, but to most people it is better known as an additive used in the preparation of different types of food (Tepe *et al.*, 2006).

- The antioxidant properties were found to be related the presence of rosmarinic acid and carnosic acid (Chang *et al.*, 1977; Cuvelier *et al.*, 1994).

- **Oregano**, a characteristic ingredient of the Mediterranean cuisine obtained by drying leaves and flowers of Origanum vulgare plants, is well known for its antioxidant activity (Economou *et al.*, 1991).

- The antioxidative property of **green tea extract** is due to the presence of catechins (Higdon & Frei, 2003; Zandi & Gondon, 1999).
- The tea catechins and other polyphenols are free radical scavengers, metal chelators, inhibitors of transcription factors, and enzymes. Therefore green tea extracts have been used as natural antioxidants, antibacterial and antiviral agents (Higdon & Frei, 2003; Manzocco *et al.,* 1998; Tang *et al.,* 2001).

- Tea catechins are a major group of polyphenolic flavonoids found in green tea. The antioxidant activity of tea catechins has been demonstrated in a variety of test systems (Huang & Frankel, 1997) and in beef, pork and poultry meats (McCarthy *et al.,* 2001; Mitsumoto *et al*,. 2005; Nissen *et al*,. 2004; Tang *et al*,. 2001).

3.2. Fruits and vegetables

- In the recent years, food scientists and nutrition specialists agree that fruits and vegetables, consumed daily, contribute to reducing risks of certain diseases, including cancer and cardioand cerebro-vascular diseases (Liu et al., 2000; Martin *et al.,* 2002).
- Waste products from processing of fruit and vegetables offer a practical and economic source of potent antioxidants that could replace synthetic preservatives. These beneficial effects have been attributed to the various antioxidants in fruits and vegetables (Huxley & Neil, 2003; Knekt et al., 2002; Peschel et al., 2006), including polyphenol, ascorbic acid, carotenoids, and tocopherols

Plum-derived food ingredients have been reported to function as antioxidants, antimicrobials, fat replacers, and flavorants. Hamburgers containing dried plum pure have been reported to retain 15.8% more moisture when reheated and held for up 4 h (Decker, 1999).

Moreover, dried plum puree at 3% and higher has been shown to be as effective as BHA/BHT in retarding lipid oxidation in precooked pork patties (Nuñez de Gonzalez *et al.,* 2008). Lee and Ahn (2005) likewise observed that plum extract used at >2% in turkey breast rolls and irradiated at 3.0 kGy was effective at retarding lipid oxidation while enhancing juiciness.

Pomegranate is an important source of bioactive compounds and has been used in folk medicine for many centuries. Most pomegranate fruit parts are known to possess enormous antioxidant activity.

Pomegranate juice has been demonstrated to be high in antioxidant activity and is effective in prevention of atherosclerosis, low-density lipoprotein oxidation, prostate cancer, platelet aggregation and various cardiovascular diseases (Adhami & Mukhtar, 2006).

- Green vegetables occupy an important role in human nutrition as they provide essential minerals and vitamins. Vegetables are also known to contain large amount of dietary fiber and phytochemicals that are natural antioxidants (Yue Xu, 2001).
- Extension of meat and meat products with green vegetables could reduce production costs and improve the nutritional qualities of the products.
- A limited number of studies have been conducted on the suitability of vegetables for use in comminuted meat products. Muller and Redden (1995) reported a decrease in fat and cooking loss due to addition of culinary beans in ground beef patties.

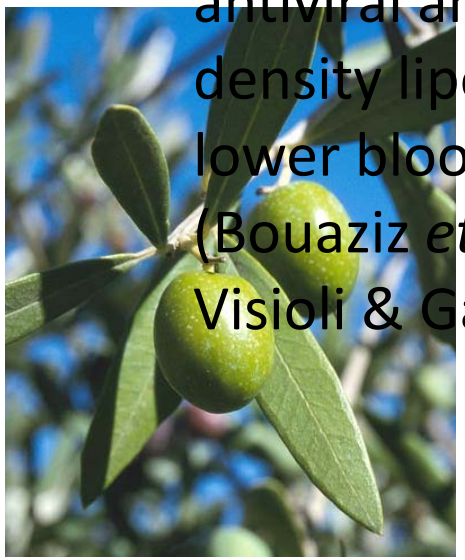
Addition of 2% carrot and 10% spinach improved the oxidative stability of poultry hamburgers (Pizzocaro *et al.,* 1998). Improvement in color, texture and vitamin A content of beef patties due to the addition of boiled carrot and sweet potato have also been reported (Saleh & Ahmed, 1998).

These findings suggest that vegetables could serve as fillers, binders, fat replacers, micronutrient fortificants, and sources of dietary fiber and natural antioxidants in a meat system (Hedrick *et al.,* 1994).

Few studies have looked at the addition of lycopene or tomatoes to meat products. Østerlie and Lerfall (2005) studied the effect of lycopene from sun-dried tomatoes, tomato paste and crystalline lycopene on the storage qualities of minced meat. Sánchez-Escalante *et al.,* (2003) have analyzed the effects of the addition of oleoresins and frozen tomato pulp containing lycopene on the colour and odour of beef patties.

3.3. Oilseeds

- Sesamol is a natural phenolic antioxidant and has been shown to significantly reduce lipid oxidation in bovine and porcine muscle model systems (Hayes et al., 2009), raw and cooked pork patties (Chen *et al.,* 1999), salami (Ghiretti et al., 1997) and turkey breast (Lee & Ahn, 2003).
- Olive leaf extract is a phenolic compound derived from olive leaves and is known to have antioxidative, antimicrobial, antiviral and anti-inflammatory properties and to protect low-density lipoprotein from oxidation; to have the capacity to lower blood pressure in animals; and to inhibit lipid oxidation (Bouaziz *et al.,* 2008; Khayyal et al., 2002; Micol et al., 2005; Visioli & Galli, 1994).



- Regarding the lipid fraction, reformulation has been used to reduce the fat content in cooked meat products (Grigelmo-Miguel *et al.,* 2000; Paneras *et al.,* 1996) and in fermented sausages (Bloukas *et al.,* 1997; Garcı´a *et al.*, 2002; Mendoza *et al.,* 2001).

- Furthermore, reformulation by replacing the animal fat by vegetable oils has been recognised as an interesting way to improve the fatty acid profile of dry fermented sausages. Olive oil was the first vegetable fat used for that purpose because of its high proportion of the monounsaturated oleic acid. Bloukas et al., (1997) found that 20% of pork backfat could be replaced by olive oil in the form of pre-emulsified fat in Greek fermented sausages.

3.4. Others

Whey is a cheap by-product from the cheese industry and is currently being investigated for its antioxidant activity (Browdy & Harris, 1997). Whey was found to contain antioxidant compounds that were heat stable and had a molecular weight of 500–5000 daltons (Colbert & Decker, 1991). Whey and whey ultrafiltration permeate have been proposed to be used as a natural antioxidant in foods (Colbert & Decker, 1991).

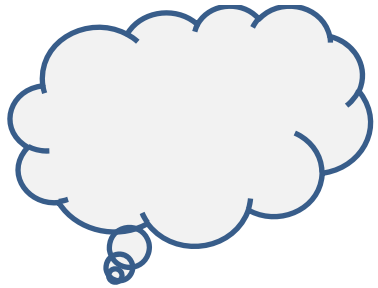
Browdy et al. (1997) demonstrated that whey powder suppressed the formation of hydroperoxides and TBARS in model systems and could be useful as an antioxidant in some processed foods. Colbert *et al.,* (1991) showed that antioxidants were present in the ultrafiltration permeate of acid and sweet whey.

- Proteins and peptides, such as whey, soy and carnosine, have also been reported to act as natural antioxidants in cooked meat (Decker & Crum, 1993; McCarthy et al., 2001; Wu & Brewer, 1994).

- Whey protein concentrate (WPC) showed a higher efficacy as antioxidant in cooked pork patties compared to soy protein isolate, vitamin E, BHA/BHT, rosemary, and ginseng, and only tea catechins showed a better oxidation inhibition (McCarthy et al., 2001).

- Lutein is a carotenoid that is present abundantly in dark green leafy vegetables such as spinach and kale, and is often termed ‘the eye-protective nutrient’ (Alves-Rodrigues & Shao, 2004) as it is one of the most important dietary antioxidants for eye health (Alves-Rodrigues & Shao, 2004; Gale *et al.,* 2001; Mares-Perlman *et al.,* 2002). Csapo *et al.,* (2006) developed a variety of meat products with added lutein to promote the advantages of lutein for eye health.

Naturally occurring antioxidants in almond skins include phenolic acids and flavonoids. Not all naturally occurring antioxidant compounds are readily available as a result of being bound to cellular components and sugars, e.g., glucose, galactose, and rutinose. Prasetyo et al. (2008) found that the application of electron beam irradiated almond skin powder (0.5% w/w) significantly lowered lipid oxidation in raw minced top round beef.



4. Conclusion

Synthetic antioxidants such as BHA, BHT and gallates were introduces in the 1940s. In recent years, there has been an enormous demand for natural antioxidants mainly because of adverse toxicological reports on many synthetic compunds. Thus most of the recent investigations have been targeted towards identification of novel antioxidants from natural sources.

- Natural antioxidants have great impact on the safety and acceptability of the food system and will continue to do so. Not only do they keep the food stable against oxidation but can also be effective in controlling microbial growth. Therefore, the influence of these ingredients on meat quality parameters merits investigation as the use of natural antioxidants may afford the meat industry an opportunity to develop novel meat products with enhanced nutritional and health benefits, improved shelf-life and quality.

THANKS..