The application of Vitamin C--- From food and beverages to cosmetic products

Vitamin C, also known as ascorbic acid or ascorbate, is a six-carbon compound (Groff, Gropper and Smith 2006) naturally found in many fruits and vegetables. It is required in many “reactions involved in body processes, including collagen synthesis, carnitine synthesis, tyrosine synthesis and catabolism, and neurotransmitter synthesis” (Groff, Gropper and Smith 2006, p 263), etc. Nevertheless, vitamin C is not just an essential nutrient for maintaining human health. In fact, due to its multiple biological and chemical properties, vitamin C plays a useful role in different areas (Johnson and Mergens 1991), such as food and cosmetic industries.

Application in food industry
In food industry, vitamin C has a dual role: it acts as a nutrient as well as a food antioxidant and product improver (Johnson and Mergens 1991). Due to its physical structure, vitamin C is highly unstable (Groff, Gropper and Smith 2006). It is extremely heat-sensitive and can be easily destroyed under various conditions, such as enzymatic reaction, exposure to oxygen or light, use of inappropriate containers, and the presence of antioxidants or preservatives (Woods 2001). Vitamin C can be significantly reduced during food manufacturing and storage process (Woods 2001). In order to replace the loss, vitamin C is restored\(^1\) back to the food products (Johnson and Mergens 1991).

As fruits and vegetables are the major sources of vitamin C, the inadequate daily intake of these food which is a common problem amount Hong Kong citizens\(^2\).

\(^1\) The term restore is defined as the addition of a nutrient to its original level presence in the food that is fully or partially lost during processing, storage or handling (Woods 2001).

\(^2\) According to data in Report on population health survey 2003-2004, the overall percentage of population that has inadequate daily fruit and vegetable intake (less than 5 serving per day) is 82.9% (Female 79.4%, Male 87.1%) (Department of Health and Department of Community Medicine c2004).
(Department of Health and Department of Community Medicine c2004) may lead to deficiency. Fortification\(^3\) of vitamin C in popular food and drinks (refers to Figure 2 & 3) may help to satisfy the needs and prevent deficiency diseases (Woods 2001).

In addition, vitamin C is used in food products as a safe and effective functional additive for many years (Johnson and Mergens 1991). It is used as an antioxidant, reducing agent, acidifier, buffering agent, solvent, etc in various food and drinks (Johnson and Mergens 1991). The ease of oxidation through either one- or two-electron transfer reaction through its unique enediol grouping (-COH=COH-) allows vitamin C to be used as antioxidant (Johnson and Mergens 1991). It is probably the most important chemical property of vitamin C which protects and improves qualities of “fruits, vegetables, meats and poultry, fish and seafoods, milk,

\(^3\)The term fortification is defined as the addition of a nutrient to food irrespective of whether or not it is normally presence in the food. The purpose of fortification is to prevent or correct a demonstrated deficiency of the particular nutrient in the population or specific groups within the population (Woods 2001).
cereal grain flours, snack foods, fats, oil, juices and beverages”, etc in either fresh, frozen or heat-treated forms (Johnson and Mergens 1991, p442). Vitamin C achieves the antioxidation function by donating hydrogen to oxygen so that oxygen is not available for oxidation reactions but instead becomes its non-reactive oxidized form (Johnson and Mergens 1991).

Also, in aqueous condition, vitamin C can react rapidly and effectively with reactive oxygen species (for example, ‘OH) prior to the beginning of oxidative damage (refers to equation 1) (Groff, Gropper and Smith 2006).

Equation 1: Vitamin C (AH$_2$) reacts with the hydroxyl radical (‘OH) to give water and the fairly non-reactive semidehydroascorbate radical (AH) (Groff, Gropper and Smith 2006) which terminates the oxidation reaction.

\[
\begin{align*}
\text{AH}_2 & \quad \text{AH}^- \\
& \quad \text{H}_2\text{O}
\end{align*}
\]

**Application in cosmetic industry**

The use of vitamin C is not only limited to food related areas; actually its applications extend to areas other than just the food and beverages industry. Like the role vitamin C plays in food industry, its excellent reducing capacity makes it an effective ingredient in cosmetic products (Parker and Parker 2004). It protects and strengthens skin tissues and cells against external attacking factors such as oxidation damage resulting from attack of free radical and oxygen-derived species (refers to Equation 1) (Groff, Gropper and Smith 2006), ultra violet radiation, pollutants and other exogenous agents which lead to formation of wrinkles, deposition of pigment, lose of elasticity of skin, etc (Berardesca, Rona and Vailati 2004, Parker and Parker 2004). Besides the protection effect, vitamin C also stimulates collagen synthesis and involves in depigmentation (Parker and Parker 2004). All these contributions of vitamin C make it a desirable topical treatment agent in cosmetic industry.

However, like what has been described in the previous section, vitamin C is highly unstable and is sensitive to environmental influences. Even slight degradation may lead to loss of function as well as yellowing of a composition containing it (Parker and Parker 2004). Luckily, thanks to the introduction of rather recent advance techniques, such as multi-encapsulation method and water-in-oil emulsion method (Parker and Parker 2004), the highly desired vitamin C can now be available as an active ingredient in different cosmetic products (Berardesca, Rona and Vailati 2004).
Instead, many popular cosmetic brands in Hong Kong have added vitamin C as a major ingredient to their various products for different functions including whitening, anti-ageing, moisturizing, controlling sebum, etc (refers to Table 1).

Table 1 showing common brand of cosmetic products in Hong Kong market that contain Vitamin C as one of their active ingredients

<table>
<thead>
<tr>
<th>Brand Name</th>
<th>Product Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinique</td>
<td>Derma White Micro-Motion Serum</td>
<td>“Rich in Vitamin C, acts as a potent weapon to directly target dark spots” (c2008)</td>
</tr>
<tr>
<td>Ettusais</td>
<td>Medicated Whitening Water</td>
<td>“Brightens skin with stable Vitamin C derivative while moisturizing skin and controlling excess sebum” (c2007)</td>
</tr>
<tr>
<td>Fancl</td>
<td>White Essence</td>
<td>“Vitamin C helps to lighten dark spots and freckles” (c2007)</td>
</tr>
<tr>
<td>Haba</td>
<td>White Lady</td>
<td>“5 major efficacies of Vitamin C: to provide a whitening effect that is natural to the skin, to even out the texture of the skin, to help Collagen production and protect bounce and smoothness of the skin, to prevent the skin from drying and chapping, to tighten the pores and suppress excess secretion of sebum, helpful for preventing acne”</td>
</tr>
<tr>
<td>Kiehl's</td>
<td>Facial Fuel SPF 15</td>
<td>“The formula, with Vitamins C ….. helps waken tired-looking skin and helps improve skin’s look and texture” (c2008)</td>
</tr>
<tr>
<td>L’Occitane</td>
<td>Brightening Serum</td>
<td>“Enhanced with an active ingredient derived from Vitamin C, the formula lightens age spots and regulates the production of melanin, for a perfectly even complexion” (c2007)</td>
</tr>
<tr>
<td>Neutrogena</td>
<td>Neutrogena Healthy Skin Visibly Even Night Concentrate</td>
<td>“Vitamin C helps revitalize the complexion” (c2008)</td>
</tr>
<tr>
<td>Olay</td>
<td>Complete All Day UV Moisture Cream SPF 15 - Normal</td>
<td>“This formula, with antioxidants vitamin E plus C, helps to promote and maintain healthy looking skin” (c2008)</td>
</tr>
<tr>
<td>Paul and Joe</td>
<td>Whitening Emulsion</td>
<td>“Vitamin C, an active whitening ingredient, controls the production of melanin and prevents blemishes and freckles that can be caused by exposure to the sun” (c2008)</td>
</tr>
</tbody>
</table>

**Conclusion**
To sum up, in Hong Kong, the application of vitamin C to a broad range of food and cosmetic products attests to the versatility of it in protecting various types of food, maintaining good health, as well as its ability in improving unfavourable skin conditions.

**Reference list**

Journal of Cosmetic Dermatology. 3:26-34.


