EFFECTS OF CAPSAICIN THE DEFENSE INDUSTRY FROM DNA PROTECTION

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1. Introduction

The main phytochemical in hot peppers are capsaicinoids. Among the capsaicinoids, 69% contain capsaicin, a phenolic compound responsible for the characteristic taste and pungency of hot peppers. Other bitterness substances are 22% dihydrocapsaicin, 7% nor dihydrocapsaicin, 1% homocapsaicin and homodihydrocapsaicin.

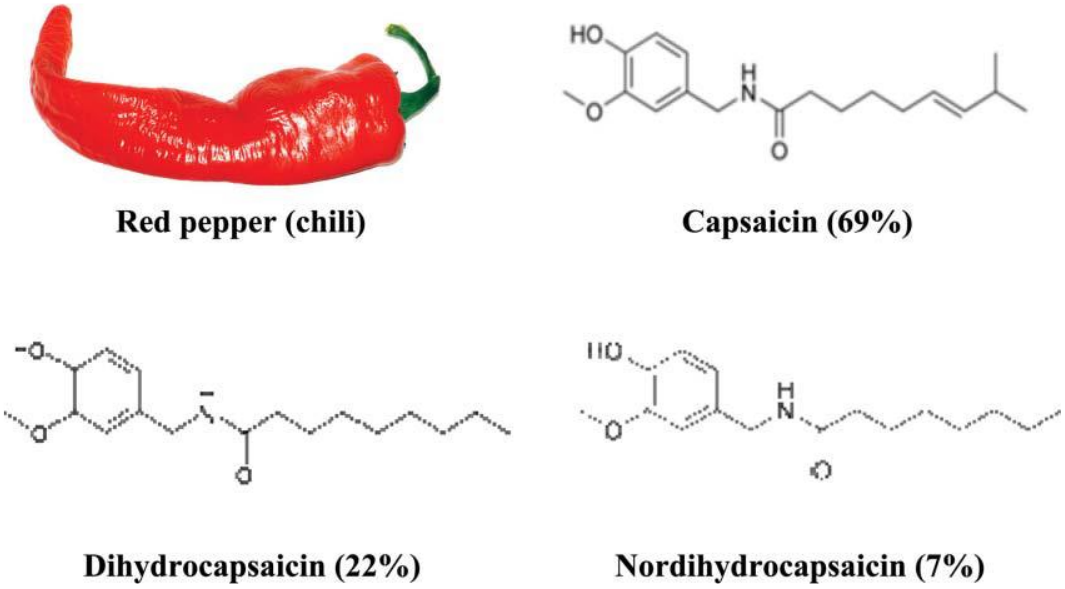

Figure 1. Red pepper and major capsaicinoids (1).

Phytochemicals such as capsascinin are known to have as many anti-oxidant and cancer-protective effects as chemotherapy drugs. Most of these bioactive substances have anti-cancer properties; It performs by stopping the progression of the cell cycle and stimulating tumor cell apoptosis (2). Red peppers contain different amounts of capsaicin.

Sweet peppers, also called bell peppers, are the most commonly known chili peperlaar in the family Capsicum annuum. Sweet peppers contain much lower amounts of capsaicin compared to hot peppers (3). Capsaicins are also important in the pharmaceutical industry due to their neurological effects as alcoioids (4). There are many studies on capsaicin antioxidants in the literature and it is well known that it has antioxidant properties (5).

2. Pepper Production

While China ranks first in the world with 16.023.500 tons of pepper production in a total area of 709.150 hectare (ha) in the world; Mexico ranks second with a production of 2,379,736 tons in an area of 136,132 ha. Turkey produces 2,072,132 tons of pepper in an area of 96,000 Ç(2018) data, the total amount of red pepper production is 179,264 tons, of which

approximately 35.28% is grown in Şanlıurfa, 30.62% in Gaziantep, 16.45% in Kilis, 9.82% in Kahramanmaraş and 1.94% in Hatay. The types of peppers grown in our country are table; kapya (for oil), bell, çarliston pepper. As a dryer; domestic peppers are such types as ornamental peppers. In addition, Hungarian pepper, Greek çarli, Chilean pepper, Jalapeno and Coarse bell (California Wonder) pepper types from block peppers with less production value are also grown. The fact that Turkey has a different ecological structure allows pepper varieties to be grown almost everywhere except for very cold regions (6). According to the official data of TUIK 2019; Tomato paste is cultivated in kapya with 879,775 tons of production and 308,417 (ha) cultivated area, Bell with 393,109 tons and 143,626 (ha) cultivated area and 313,149 (ha) cultivated area and Çarliston with 115,568 tons of production in 27,425 (ha) cultivated area (7).

According to The Observatory Of Economics Complexity (OEC) data, pepper, which is the 573 rd most traded product with a trade of 3.8 billion dollars, accounts for 0.021% of world trade.

The leading exporting country of the processed pepper sector was India with approximately 1.2 billion dollars according to 2020 data. In the same year, the leading importing country was the United States of America (USA) with 648 million dollars of imports (8).

3. Uses of Capsaicin

Capsaicin is the main bitterness component found in Capsicum species. Capsacin is used as a spice and flavoring. However, capsaicin is also used for medical and therapeutic purposes due to its pharmacological and physiological effects. In addition, capsaicin is also used against pests such as insects and mites, especially in organic agriculture, and some pathogenic fungi and bacteria (9). Hot pepper, which is consumed as a spice in many parts of the world, is widely used in the field of medicine due to the capsaicin it contains. Plants that are medically important have been used for the treatment of diseases among the people for centuries. Capsaicin has many applications in industry. Capsaicin is a homovalinic acid derivative and a fat-soluble phenol (10). Capsaicin is used extensively today in the fields of food, health and cosmetics. The most common use of capsaicin product is in the food sector due to its bitter properties. In addition, sauce production is among the fastest growing sectors of the Turkish economy. The demand for sauces is increasing with demographic consumption trends. When the two data are evaluated, the use of capsaicin in sauce and tomato paste production is an indication that the prevalence of commercial use will increase. Another use of capsaicin due to its antioxidant, painkiller and anti-tumor properties is in medical products. Capsaicin components reduce the transmission time of pain impulses by reducing substance P, which plays an active role in the transmission of pain in the central nervous system. In this way, it shows pain relief properties. Therefore, capsaicin is used locally to relieve the pain caused by herpes and shingles and to help reduce the pain caused by muscle, nerve and joint disorders. However, it has an important use in the cosmetic sector due to its nourishing and anti-hair loss properties (11).

Although the relationship with capsaicin cannot be proven by official data, it has been reported that in countries such as Thailand, where pepper consumption is high, cases of cancer caused by the digestive system are less common than in countries where consumption is relatively low. Research in Japan and China reveals that natural capsaicin components inhibit the development of cells with leukemia. Capsaicin is used as a raw material for tear gas used to intervene in

social events or for personal defense. It has also been found to be used in the wood industry as a preservative against sphaeropsissapinea and leptographiumprocerum fungi that cause wood discoloration. Another identified use of capsaicin is that it can be considered as an alternative to toxic paints. In an environmental risk assessment, it was shown that capsaicin is an alternative substance that can be used instead of toxic paint, especially on boats (12).

Another sector in which capsaicin is widely used is the agricultural sector. Capsaicin increases the endurance of the plant due to the fact that it causes an increase in some defense enzyme levels such as chitinase protein. Capsaicin is used against some pathogenic fungi and bacteria as well as its removal feature for pests such as insects and mites, especially in organic agriculture. It has been observed that it is effective for 2 months in removing pests such as aphids, red spiders, which have significant damage to natural pesticides, from the plant. Capsaicin prevents seed germination and prolongs germination time. For this reason, it is used effectively in agriculture, especially in the prevention of weeds. It is seen that capsaicin product is also used in livestock activities that can be evaluated within the scope of the agricultural sector. It has been found that especially if capsaicin is added to the chicken ration, it has stimulating effects on the metabolic activities of chicken. In this way, as a result of increased enzyme movements and fat burning, more efficient offspring and eggs can be obtained in chickens (13).

4. Health Effects of Capsaicin

Capsaicin is a secondary metabolite, the most important phenolic component synthesized from peppers, which allow plants to adapt to biotic and abiotic stress conditions (infection, injury, water stress, cold, and high light) (14). In living systems, the oxygen consumed during catabolism can be transformed into various radicals with high efficiency. The most important target of these molecules, known as reactive oxygen species, is DNA in the carcinogenesis process. Irreversible DNA damage can lead to carcinogenize, aging, and other degenerative diseases (15). Oxidative damage from free radicals may be responsible for the onset and progression of many chronic diseases, such as cancer, inflammation, and cardiovascular disease. In recent years, the antioxidant properties of natural compounds have been determined by examining the potential antioxidant components they contain (15,16). There are studies on the antioxidant effect of capsaicin in the literature and it is well known that it has antioxidant properties (17). Since capsaicins are alcoioid class compounds, they have a neurological effect and are therefore important in the pharmaceutical industry (18). Many studies have shown that capsaicin has potential antimutagenic and anticarcinogenic activitis (19). Capsaline has also been reported to selectively induce apoptosis in cancerous cells. (20) In addition, a positive relationship is reported between pepper consumption and the prevention of gastric cancer, pancreatic cancer and lung cancers in epidemiological studies (21).

One of the most effective radicals in metabolism is the hydroxyl and hydrogen peroxide radical, which can easily attack nucleotides and cause permanent damage to the structure of DNA, the most important inherited nucleotide (22). In the presence of H_2O_2, exposure of DNA to UV rays causes open-circular DNA to break and form linear DNA (linDNA; one or more fractures in both chains) (23). In the meantime, genetic disorders may occur as a result of breaks in the

DNA chain. Irreversible DNA damage can lead to carcinogenize, aging, and other degenerative diseases (24).

It is known that UV rays reaching the earth with the destruction of the stratosphere layer have negative effects on living things. UV rays cause serious diseases resulting in skin cancer and skin aging. Topical application of enzymatic and non-enzymatic antioxidants is an effective approach to protect the skin against the harmful ethics of UV rays (25). In fact, human skin has a number of mechanisms that will reduce the harmful effect of VIS (visible rays) and UV rays. However, high levels of exposure to UV rays can lead to a decrease in the amount of cellular antioxidants and ultimately to UV-induced oxidative DNA damage caused by reactive oxygen species. In addition to UV rays, free radicals can also cause DNA damage. For example, hydrogen peroxide, a type of free radical, causes DNA damage by converting guanine to 8 hydroxyguanine (26). Many studies have found that capsaicin has a protective effect on genetic material. Many studies have found that capsaicin has a protective effect on genetic material. Capsaicin extracted from green peppers grown in the Southeastern Anatolia region has been found to have a very good level of DNA-protective activities in different solvents and has been shown to have a protective effect on DNA even at low concentrations (27).

5. Capsaicin in the Defense Industry

Tear gas, pepper spray or OC gas, OC spray (OC="Oleoresin Capsicum") is a tear gas used in police work, riot and mayhem checks, personal self-defense, protection against animals such as bears and dogs (which may contain chemical compounds that cause uncontrolled tear flow in the eyes, irritating the eyes due to pain and even temporary blindness) (Bear Spray Vs. Dogs: How Effective Is It?", 2009 and Tbotech.com. "Pepper Spray", 2015).

According to the Scoville bitterness test, which is used to measure the bitterness of peppers and is the first test, the amounts of red pepper varieties and capsaicinoits were determined according to pepper types. The bitterness rate is directly proportional to the amount of capsaicin and contrary to what is known, capsaicin is also found in sweet bibes (Bayıl Oğuzkan, S and Uğraş, 2019).

Pepper spray production, the active ingredient of which is capsaicin, is generally produced from red chile pepper and cayenne pepper throughout the world. In a study in which red pepper varieties and capsanoites were investigated as scoville units, the highest capsphenoid content was found in Haberano, which grows on the Yucatan Peninsula, and the lowest was found in new Mexican peppers (Kadakal and et al., 2001). Therefore, pepper spray can be produced from different types of peppers with the appropriate purification method without even the need for Haberano pepper, which has the highest capsaicin content.

Pepper spray is produced in three different spray formats among itself.

1- OC (Oleoresin Capsicum): It is the most common and known form of tear gas. The active ingredient is capsaicin. Other auxiliary materials are filler materials. Capsaicin is not a water-soluble substance. Victims are advised to move their eyelids frequently to produce more tears and not rub their hands on their eyes, faces.

2- CS (Orthochlorobenzalmalonitrile): It is known as tear gas. It can be used alone or with OC. CS is a very effective type that is most popularly used. It makes victims passive and is active enough to cause vomiting.
3- CN (Alphachloroacetapheone): It is a form of gas bomb used by military and police organizations for defense purposes. It can lead to temporary loss of balance and skin problems. The effects of CN gas last longer than CS.

When we compare these three forms of gas spray, it is known that OC, whose active ingredient is close to 95%, is in more organic form than the others and does not leave long-term damage. For this reason, we can say that the use of spray forms with capsaicin active ingredient is important for defense and for the humane treatment of both victims and victims. In recent years, the production and use of plant-based organic weapons, the active ingredient of which is capsaicin, has become widespread.

It is known that capsaicin extracts obtained from pepper were encapsulated and started to be used as weapons. The effects of capsaicin, which has a wide range of uses for both defense industry and medical purposes, are examined in this section. Although it is important to improve both the cultivation areas and the production conditions of pepper, which is also very common in dietary consumption, we think that different methods should be developed for the production of the active substance. In addition, not only the benefits of dietary intake but also the importance of capsaicin, which is used at a simple level as a means of personal defense, is discussed in this article.

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