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Metal nanoparticles with biocide properties. Potential uses for food preservation

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Food companies face different challenges on the international level at present when speaking of food safety, consumer acceptation, and regulatory compliance [1-4]. The complexity of current food-related problems can be really difficult because of the interconnection of many variables. In fact, the food industry is one of the main vital sectors of the current industrial world. The necessity of fast and immediately available food commodities in many Countries has to be seriously taken into account as one of the main pressure elements when speaking of social equilibrium and antagonist effects [5-7].

In general, food safety and public health issues concern the following arguments and topics: microbiological contaminations, detection of unallowed and/or probably undesired chemical compounds perceived as "foreign constituents", non-food related physical contamination (wood, metals, glass, plastic matters, radioactivity), intentional (economically motivated) food adulteration, etc. [8-10]. On the other hand, it should be admitted that the main perceived risk by food consumers is related to food illnesses with microbial causes. In fact, the First Law of Food Degradation clearly implies that food products are irreversibly modified during time with various effects, including perishability as the result of microbial spreading and consequent food unacceptability [11-14].

As a clear result, many efforts have been reported so far with concern to antimicrobial activity of certain additives in foods. The use of antibiotics and similar compounds as food additives or preservative agents has been studied with interesting and promising results: certain natural substances such as chitosan may be considered for similar purposes because of their broad spectrum action and the possible incorporation in the plastic matrix of packaging materials [15-18]. On the other side, the psychological impact of these compounds on the behaviour of food consumers and the real effects on human health should be considered carefully.

Another strategy against microbial (degradative and pathogen) agents may consider the use of metal nanoparticles as part of current food safety strategies [19-21]. The antimicrobial role of certain metals and related compounds is known from centuries: in addition, antifungal and insecticide properties have been extensively reported so far. In particular, the following metals and metal oxides – silver and silver dioxide, silicon and silicon dioxide compounds (in association with silver or gold also), calcium and magnesium oxides, copper monoxide, gold, titanium dioxide, and zinc oxide, - have been repeatedly studied and considered as possible antimicrobial agents, although it should be considered that similar compounds may have other technological roles without food safety relation [22-24].

Silver and silver-based nanoparticles are extensively reported in the scientific literature because of their strong antimicrobial properties [25-26]. Apparently, these features are linked to the observed damage of outer microbial membranes and interfering activity against normal metabolic processes by means of the interaction with enzymatic sulfhydryl or disulfide groups [19,27-28]. In addition, the reduced dimension of nanoparticles seems to enhance antimicrobial properties; as a result, the interest in silver and silver oxide (Ag_2O) nanoparticles has been notably increased in recent years. Finally, silver appear to show less toxic effects if compared with other sustances able to fight microbial activity [19]. However, other metal or metal oxide-based nanoparticles side (silicon and silicon dioxide, gold) can be helpful in this ambit because of their recognized antimicrobial activity on the one hand and their non-toxic features with relation to human safety on the other side. For these reason, correlated researches could be extremely useful in this ambit [19,29].

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