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Collagen Extraction from Egg Shell Membrane and its Applications

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1. Introduction

The egg is of great importance for all strata of Brazilian society, as it is presented as one of the main inputs for the entire food industry, as well as is of high nutritional value. (PONKHAM et al., 2011) [1]. According to FAO, world egg production was more than 62 million tons in 2008, with China being the leader with 37.6% production (EMBRAPA, 2011) [2]. Brazil, in turn, continues to increase its production year after year, with more than 39 billion units registered in 2016, a total that placed the country as the seventh largest producer in the world.

Following this reasoning, the eggshell can be readily collected anywhere in abundance, as a common industrial waste species, as it is still considered unfit for consumption. The shell represents about 11% of the total weight of the eggs, and thus, the waste generated can be estimated at about 7.21 million tons per year in the world, despite containing useful chemical components (OLIVEIRA et al., 2009) [3]. However, several studies prove that the eggshell and the membrane that covers its internal part exhibit numerous possibilities of technological applications.

The egg shell membrane consists of organic materials, which include valuable biomaterials such as collagen, polypeptides and amino acids (WONG et al., 1984) [4]. Glycoproteins, which are more present in membranes, consist of collagen type I, V and X, which are very useful in the production of cosmetics, as well as in the medical application (OLIVEIRA et al., 2013) [5].

Collagen, considered one of the most important proteins in the human body, because it is essential for the structure, integrity and health of bones, joints, skin, hair and organ support, represents about 30% of all protein present in animal organisms (RICARD-BLUM, 2011) [6]. However, due to its characteristic of natural degradation and the gradual fall of its production process in the body, and also due to the consequences of the lack of this protein for the organism, it is born, both for the pharmaceutical and cosmetic industries, an important value for obtaining this group of proteins to manufacture supplement as a replacement of a much needed compound (PRESTES et al., 2013) [7].

However, it is known that much of the production of collagen supplements comes from bovine or porcine origin, this being a more expensive breeding process, less bioavailability, and that there is a risk of contamination and spread of various diseases caused by prions (LONG et al., 2004; SADOWSKA et al., 2003) [8,9].

Despite containing these useful chemical components, the shells have not yet gained sufficient attention regarding the conversion of their residues into new materials (MACNEIL, 2001; DEJONG et al., 2013) [10,11].

In this context, this study aims to present a brief history of the different types of collagen, as well as the biosynthesis, function and degradation of collagen already studied and the harms of the deficiency of this protein.

2. Methodology

The methodology used in this study consisted of a survey of data in the literature, regarding the comparison of the advantages and disadvantages of collagen extracted from egg shell in relation to other sources of collagen and on the possibility of extraction and use of this collagen. The results obtained are presented in the next item of this study.

3. Results and Discussion

Joint and connective tissue disorders are extremely common and result in significant costs, both financial and quality of life, for those suffering from debilitating diseases. Thus, it was evident that the ingestion of collagen brings benefits to the body, such as the improvement of skin firmness, protection of joint damage, improvement in the treatment of osteoporosis, prevention of aging, among others.

The egg shell membrane has proved to be an important source for collagen extraction, considering that it is also a source of other components working in synergy with collagen, such as glucosamine, chondroitin sulfate and hyaluronic acid, and which today are commonly incorporated into collagen capsules, for the purpose of treating cartilage diseases.

Some studies have indicated positively the efficacy and safety of treating joint disorders with natural egg shell membrane. All the results of the studies show a decrease in pain and a considerable improvement in flexibility in the joints and/or in the affected areas. In addition, it has been proven that this treatment has the added benefit of avoiding the side effects associated with long-term use of other drugs or anti-inflammatory treatments.

Despite the proven advantage of extracting collagen from the egg shell membrane, very little has been done to accomplish this process. According to the research presented in this work, the process of implementing a new stage for the separation between the eggshell and its membrane would be very costly. Still, it was reported that the number of patents describing and/or developing effective methods for this purpose has grown greatly.

During the present study, it was observed that the capacity of extracting collagen from the membrane of the egg shell depends on the relationship between the membrane and the acid used, and in the ratio between membrane and acetic acid, the extracted collagen was increased 4 times more. In a dry sample of 100g the extracted collagen content was about 507 and 495mg by extraction with acetic acid and citric acid, respectively (POKHAN et al. 2011) [1].

Whereas bovine collagen yields (tendons), according to Alexandre et al. (2017), ranged between 1.42% and 10.75% [12]. However, the same authors, after an adaptation of the extraction methodology, obtained a 36% yield, also using acetic acid as solubilizer. In the study carried out by Wang and collaborators (2008) the extraction of collagen from carp skin obtained a 19.7% yield in the optimized extraction [13]. In the study by Sadowska et al (2003), a 20% yield was obtained using cod skin [9].

This corroborates with the idea that the yield of collagen will depend on the methodology applied for its extraction, moreover, it raises the hypothesis that the raw material used does not necessarily determine the quality.

4. Conclusions

As can be seen from the present study, the collagen industry is responsible for adding great commercial value to animal waste that would otherwise contribute to the accumulation of volume in landfill and landfill

systems, these are well saturated. Over time, more studies on possible alternative sources for the production of this protein are also aimed at meeting the growing demand for it.

In this scenario it is of paramount importance that several studies are carried out to establish the best methods for which sources. Brazil, in this regard, mainly targets sources of bovine and pyskean rejects. Unfortunately, despite being among the world's top 10 egg producers, Brazilian research focusing on the use of the egg shell membrane is of little importance compared to other countries.

In the case of collagen extraction from the egg shell membrane, this process presents some difficulties compared to other sources, such as the need for a pretreatment separation between membrane and shell, which would require a high investment from the egg processing industries, since almost all of it was not designed for such a process. Importantly, the isolation of collagen from this source is not as beneficial as the consumption of the egg shell membrane in an integral way.

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