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Gelatin : mini–review

AMER MAHDI
State Key Laboratory of Food Science and Technology
School of Food Science and Technology, Jiangnan University
Wuxi, P. R. China
Deparatment of of Food Science and Technology
Faculty of Agriculture, Sana'a University
Sana'a, Yemen
WALEED AL-ANSI
State Key Laboratory of Food Science and Technology
School of Food Science and Technology, Jiangnan University
Wuxi, P. R. China
Deparatment of of Food Science and Technology
Faculty of Agriculture, Sana'a University
Sana'a, Yemen
ANWAR NOMAN
State Key Laboratory of Food Science and Technology
School of Food Science and Technology, Jiangnan University
Wuxi, P. R. China
Deparatment of Agricultural Engineering
Faculty of Agriculture, Sana'a University
Sana'a, Yemen
AMMAR AL-FARGA[1]
State Key Laboratory of Food Science and Technology
School of Food Science and Technology, Jiangnan University
Wuxi, P. R. China

Abstract:

Gelatin or Gelatine is a type of insoluble protein produced by hydrolysis of collagen extracted from a variety of animal sources such as the skin, bones, and connective tissues. Considered gelatin is the structural mainstay and most common protein in the animal kingdom. Gelatin has been widely used in food additives and healthy food due to its high content of protein and amino acid. The gelatin have unique

[1] Corresponding author: ziyadamer2@yahoo.com

hydrocolloid nature, it has enabled it to find numerous applications in the food industry. These can be divided into four main groups namely; confectionery, jelly deserts, dairy products, and meat products. In this review it has been in brief touched on the protein structure of gelatin, types and bloom of gelatin, properties associated with gelatin, sources of gelatin, production of gelatin, the mechanism of gelatin gelation and application of aelatin in food.

Key words: Gelatin, Structure, Properties, Sources, Production, Application.

INTRODUCTION

Gelatin or Gelatine, which is mainly composed of 50.5% carbon, followed by 6.8% hydrogen, 17% nitrogen, and 25.2% oxygen, is a type of insoluble protein produced by hydrolysis of collagen extracted from a variety of animal sources such as the skin, bones, and connective tissues. These sources are normally generated as a by-product following animal slaughter by the muscle food processing industry (meat, poultry, and seafood) (1). Gelatin is a substantially pure protein food ingredient, obtained by the thermal denaturation of collagen, which is the structural mainstay and most common protein in the animal kingdom (2). Gelatin has been widely used in food additives and healthy food due to its high content of protein and amino acid. Edible gelatin is made from animal hide and bone through the processing techniques such as defatting, pulverization, freezing and drying (3). The unique hydrocolloid nature of gelatin has enabled it to find numerous applications in the food industry. These can be divided into four main groups namely; confectionery (mainly for providing chewiness, texture, and foam stabilization) and jelly deserts (to provide creaminess, fat reduction, and mouth feel), dairy products (to provide stabilization and texturization), meat products (to provide water-binding), and hydrolyzed gelatin applications (4).

PROTEIN STRUCTURE OF GELATIN

Gelatin is a mixture of different polypeptide chains, α-chains, ß-chains (dimers of α-chain), and γ-chains (trimmers of α-chain). An α -chain has one peptide chain, a ß-chain consists of two peptide chains that are still connected, and a γ-chain is composed of three connected peptide chains. Gelatin that contains higher quantities of α-chains exhibits higher gel strengths (5).

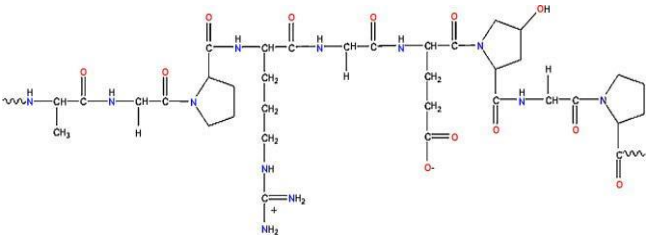

Fig. 1. Representative gelatin structure: -Ala-Gly-Pro-Arg-Gy-Glu-4Hyp-Gly-Pro-

TYPES AND BLOOM OF GELATIN

Gelatin can be classified into two types and this is determined by gelatin pretreatment during the gelatin manufacturing process. Type A gelatin with an isoionic point of 6–9 is obtained from acid-treated collagen, whereas type B gelatin (isoionic point of 5) is derived from an alkali-treated precursor. Gelatin derived from pig skin is normally referred to as type A gelatin and gelatin derived from beef skin is referred to as type B gelatin (6).

PROPERTIES ASSOCIATED WITH GELATIN

Gelatin is translucent, almost tasteless and odorless, brittle, easy to digest, and a nonallergenic protein. Dry gelatin has a moisture content of about 10%. Generally, gelatin is processed into powder or granulated form. The color of the powder

depends on the gelatin source. For example, gelatins derived from cows and pigs possess a yellowish color compared with gelatins derived from fish. Gelatin derived from pork skin also has less color than gelatin derived from bone or hide. However, color generally does not influence the properties of gelatin (5). Gelatin has great functional properties. The properties of gelatin are dependent on a number of factors, such as collagen type, gelatin source, age of the animal at slaughter, and processes used to generate gelatin. Differences in amino acid composition, such as content of α-, ß-, or γ-chain components and degree of molecular weight, can be affected by these factors (7). Gelatin is pure, natural, and not chemically modified. It has a high amino acid content. Unlike collagen, gelatin is soluble in hot water. It is unique since it is a thermo reversible gel, possesses a unique melt-in-the-mouth property (melts at lower temperature compared to other forms of hydrocolloids), and has a wide application range within the food industry. Gelatin has also been widely used in pharmaceutical, cosmetic, and photographic industries (5).

SOURCES OF GELATIN

Commercial gelatins have traditionally been obtained from pigs (porcine) and cattle (bovine) sources and derived from the skin, bone, and hide. However, gelatin derived from these sources are limited in some respects as they cannot be used or consumed by Muslims, Jews, or Hindus on various grounds (8). Alternatively, gelatin is derived from marine sources. Gelatins from fish sources are obtained as a by-product from fish processing or from fish waste. About 30% of fish waste is in the form of bone and skin, which consist of a high collagen content. These types of gelatins have never been associated with prions, are religiously acceptable, and may possess unique functional properties (9). Recently, poultry sources like chicken skin, feet, meat residue, and bones are also being developed to obtain

gelatin. Gel strength of chicken-derived gelatins may give higher bloom values than that of beef gelatins, the differences again being attributed to intrinsic characteristics such as amino acid content (higher imino acid, which is essential for gelling effect), molecular weight distribution, type of extraction treatment, and properties of collagen (10). Gelatin derived from insects is also being considered as additional sources of gelatin. Melon bugs (Aspongopus viduatus) and sorghum bugs (Agonoscelis pubescens) are processed to produce oil that is utilized for medicine and cooking purposes. Gelatin can also be extracted. This type of gelatin has all of the essential amino acids, yet the quantity of the insect protein produced is only in the moderate range (11). Potential sources of collagen from alligator bones and giant red sea cucumber are also being studied. Alligator bones are identified as possessing collagen type I with imino acid contents, which are very similar to subtropical fish species and lower than that obtained from bovine skin (12).

PRODUCTION OF GELATIN

There are a large number of unit processes used in the production of gelatin from ossein, pig skin, cow hide, and fish skin. The production process for gelatin includes following steps: pretreatment, washing, extraction, purification, drying, grinding, blending and quality control. There are basically two processes by which collagen is processed to gelatin(5);

1- The acid process is mainly used with pig skin and fish skin and sometimes bones raw materials. In this process collagen is acidified to about pH 4 and then heated, denatured, defatted, filtered, concentrated, then drying by passing dry air over the gel. The obtained product is grinded and blended to customer requirements and packed. The resulting gelatin has an isoionic point of 7 to 9 based on the severity and duration of the acid processing of the collagen which causes limited

hydrolysis of the asparagine and glutamine amino acid side chains (13).

2- The alkali process is used on bovine hide and collagen sources; in this process collagen is submitted to a caustic soda or lengthy liming process prior to extraction. After the alkali processing, the collagen is washed and treated with acid to the desired extraction pH. The collagen is then denatured and converted to gelatin by heating, then vacuum evaporated, filtred, gelated, dried, grind and blended (13).

THE MECHANISM OF GELATIN GELATION

Gelatin forms gels similar to those of carbohydrates by forming a micro-structural network. It is unique in that, at concentration as low as 1.0% it will form a thermoreversible gel. The gel converts to a solution as the temperature rises to 30°C to 40°C, thus gelatin gels tend to melt in the mouth (14). This is the desirable properties in ready to eat food such as clear dessert jellies and marshmallows. The well accepted mechanism of gelatin gelation is the random coiled helix reversion. The amino acid rich regions of the different polypeptide chains act as potential junction zones in that, upon cooling they take up a helical conformation resulting in the three-dimensional gel (15).

APPLICATION OF GELATIN IN FOOD

Gelatin is generally recognized as safe food ingredient and easy to use. Therefore, this material is utilized in many food products owing to the versatility of the ingredient, which can deliver the following functions: gelation, binding, water binding, emulsifying, foaming, film forming, elasticity, and viscosity. Adding gelatin to food products does not affect the flavor of original food products because it has a neutral flavor and odor. The variation of applications and its functions are

influenced by the processing condition, bloom value, type of gelatin, viscosity, and percentage used. For example, texture and hardness of low-fat products can be altered by adjusting the gel strength or changing the concentration of gelatins (12).

1- Meat Products

Gelatin has been used as a binder and glazing agent in meat products and used to help set meat shape in canning applications. High bloom strength gelatin has also been used to gel the fluids of jellied meats allowing the pieces of meat to form certain shape. For sausage manufacture, collagen/gelatin has been used as edible casings as collagen/gelatin offers good uniformity of appearance and strength (1).

2- Bakery and Confectionary Products

Gelatin can also act as a stabilizer and can help to maintain crystal structure of sugar for bakery products such as icing, glazes, creamy fillings, and marshmallows. Additionally, because of its whipping and stabilizing properties, gelatin has been added to topping, mousse, and chiffon-type products. Gelatin is used in confectionary for its gummy properties. Gelatin is used as a coating material before filling processes commence in order to prevent oil and moisture migration occurring from inside the product to the external product surfaces (1).

3- Dairy Products

In dairy products, gelatin is widely used due to its compatibility with milk proteins. It acts as an excellent stabilizer due to its gelling and water-binding actions, particularly for yogurts (including low and nonfat yogurts). It helps to improve yogurt texture by assisting in the development of smooth, creamy, and delicate mouthfeel properties while at the same time prolonging product shelf life. gelatin used in concentrated cream or thickened cream. Small amounts of gelatin are frequently

added to buttermilk and margarine to avoid separation and again promote smooth product textures. Gelatin also helps to stabilize the emulsion during spreading and storage. Additionally, high demands for low and nonfat dairy products give rise to the opportunity for gelatin use since it has unique 'fat-like melting characteristics' that mimic full-fat products. For cheese products like cottage cheese and cream cheese, gelatin acts as water binder and fat replacer (1).

4- Dessert Products

Gelatin also has been used as one of the main ingredients in desserts, such as puddings, custards, ice cream, and milk ices as again it provides a unique texture, is a good stabilizer, possesses excellent gelling properties, and provides melt-in-the mouth and unique mouthfeel properties (1).

5- Wine and Juice Products

Gelatin is being used in beverage products to clarify wines, beers, unfermented juices, and vinegar. These beverages normally contain insoluble matter that creates a haze or cloudiness and is impractical to remove. Therefore, gelatin has been applied for the clarification process or fining (1).

CONCLUSION

Gelatin is a type of insoluble protein produced from a variety of animal sources. Gelatin is the structural mainstay and most common protein in the animal kingdom. Gelatin has been widely used in food additives and healthy food. There are several methods for the production of gelatin. The gelatin has numerous applications in the food industry.

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