

# GELATINE CLARITY

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The **Clarity** of gelatine solutions is the desirable property. High clarity is achieved in the absence of insoluble particulate matter which scatters light (and causes **cloudiness** in solutions.) Ideally, the clarity of gelatine in aqueous solution should be equal to that of distilled water but for various technical reasons this is not possible. Hence it is necessary to understand and measure the deviations from the ideal. This can be done using ‘turbidity’ (Optek Website, June 2012) for which there are EPA approved Formazin standards for comparative purposes.

There does not appear to be any specific research on gelatine clarity but one can learn from what we already know.

Collagen is a water insoluble connective tissue animal protein which is made up of water soluble alpha chains (MW  $\pm$  100 000) which cross-link to form a water insoluble polymer. As the animal ages the initial collagen cross-links are stabilised by rearrangement of the double bonds between alpha chains. With young animals, the cross-links can be destabilized or hydrolysed in water by mild heat (50°C) to release the alpha chains into solution but as the animal ages the destabilization temperature rises and with relatively old animals it appears that temperatures of up to 100°C are unable to denature all the collagen and release the alpha chains into solution. (Cole & Roberts 1997). This means that part of the collagen of skin and bone may not be convertible into soluble protein. Other than this there are components of skin like the epidermis which is composed of keratin, which can not be solubilised in water by heat.

Gelatine is formed by the denaturation or solubilisation of the parent protein collagen found in skin and bones. With pigskin, because the animals are relatively young, the skin is simply acidified to the desired extraction pH and then heated to denature and solubilise the collagen. With bovine hide, due partly to the greater age of the animal at slaughter, it is necessary to subject the hide to depilation with sodium sulphide and alkaline hydrolysis of the stabilised cross-links by steeping in a lime suspension for a period of 1 to 6 weeks.

Gelatin in solution, because of the high molecular weight of the protein, exists as a colloidal solution which scatters light, hence simple transmittance should not be used as a measure of “clarity”. The clarity of gelatine solutions should be measured using “nephelometry” in National Turbidity Units (NTU) which measures the amount of light scattered from the light path at 90° as well as at 25° and compares it to the transmitted light beam, using a 4% solution of gelatine at 40°C. However, many manufacturers find % Transmittance at 640nm a sufficient measure of clarity for practical purposes.

Non-settling and unfilterable particulate matter in gelatine solution is the cause of “cloudiness” and has several causes:

- A gelatine stabilised emulsion of the fat emanating/released from the raw material during extraction. (A gelatine stabilised emulsion is almost impossible to break or remove by physical means.)
- A gelatine stabilised suspension of water insoluble material from the raw material (cross-linked collagen, keratin, elastin etc.) .
- With bone gelatine cloudiness can also be formed by the precipitation of traces of calcium phosphate due to pH changes.

- With bovine gelatine, hide that has been subjected to excessive lime treatment (known as ‘over-conditioning’) can become very slimy during extraction and this appears to lead to the stable suspension of insoluble material in the gelatine solution.

In order to prevent the type of cloudiness caused by unfilterable particulate matter it is necessary to treat the acidified raw material with great gentleness:

- To avoid breakup of the collagen thereby separating the epidermal keratin and any insoluble collagen into fine particles that can be stabilised by the gelatin. (The means of transporting acidified bovine hide from washing and acidulation to extraction can be responsible for such breakup of the raw material.)
- To ensure that the gelatine liquor is never subjected to violent agitation such as to break down fat globules into fine particles that can be emulsified by the gelatin in solution. (To this end it is desirable to ensure that gelatine solution sent for processing [filtration, ion-exchange, concentration, sterilization, gelling and drying] should be free of contamination by fat from the raw material. Hence any form of stirring or agitation during extraction must be minimised and preferably avoided, thus allowing any fat released from the raw material to float while gelatine solution is removed from the bottom of the extractor. When this form of extraction is not viable then centrifugation to remove fat from the gelatine solution as a first step after extraction can be used.)

It is possible to test the intrinsic clarity of extracted gelatine from raw material: Take a two to five liter sample of the raw material ready for extraction in a glass beaker and cover the material with hot water. Loosely cover the beaker and place in a 50°C oven or water bath for at least 5 hours. Note that the beaker’s contents should NOT be agitated in any way. The collagen should exhibit substantial shrinkage after the 5 hours. Carefully separate the undissolved collagen from the water using a sieve or colander. The separated gelatine solution should then be gravity filtered through a Number 1 porosity glass fiber or paper filter. If the gelatine filtrate is not sparkling clear then the raw material has been subjected to excessive physical damage during pretreatment.

If the above shows that the raw material for extraction has not been maltreated then if the production gelatine solution does not behave similarly this would be due to liquor maltreatment (agitation or pumping) during or after extraction.

Finally, a cloudy ca. 6% gelatine solution, if simmered for about 16 hours, will usually become clear, indicating that insoluble collagen responsible for the poor clarity had hydrolysed and dissolved, thus removing the source of turbidity. The clear solution is usually dark in colour as would be expected of stably cross-linked collagen. Any keratinous solids coagulate and settle easily.

#### References:

Cole,C.G.B. and Roberts, J.J. **FURTHER EFFECTS OF ANIMAL AGE ON THE ALKALI PROCESS GELATIN MANUFACTURED FROM BOVINE HIDE.** *Proceedings of the Centenary Conference of the International Union of Leather Technologists and Chemists.* London. 1997.

Cole,C.G.B. and Roberts, J.J. **GELATINE COLOUR MEASUREMENT.** *Meat Science.* 45(1). 1997.

Optek. **TURBIDITY UNITS OF MEASURE.** [http://www.optek.com/Turbidity\\_Measurement\\_Units.asp](http://www.optek.com/Turbidity_Measurement_Units.asp). June 2012.