

Does the amount of water affect the setting time and the structure of gelatin?

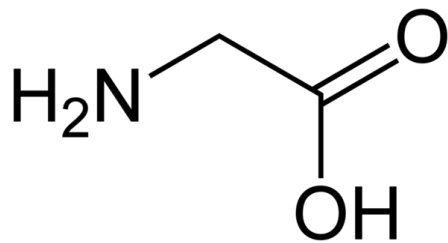
Goal:

The Goal of my project is to answer a hypothesis:

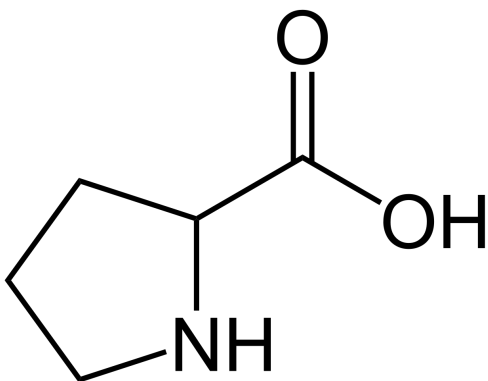
“Does the amount of water affect the setting time and the structure of gelatin?”
on the basis of the knowledge and experience gained during it.

Theoretical part

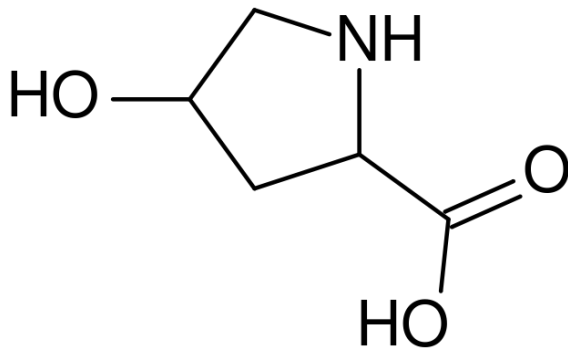
Gelatin (ATC: B 05 AA 06) is a natural substance (animal source). With a high molecular mass (50000-100000 u). It does not occur in nature on its own, but is produced through a number of complex processes. It is distinguished by its gelling properties - when dissolved in water, it forms a thick solution with a gel-like structure. It has no taste or colour. It is easily dissolved in water at temperatures of 50-60°C. It is a protein extracted from collagen which is found in the connective tissues of animals. It is most commonly extracted from the bones, tendons and skin of farm animals such as cows and pigs. Gelatin is composed of three basic components: glycine(C₂H₅NO₂), proline(C₅H₉NO₂) and hydroxyproline(C₅H₉NO₃).



glycine(C₂H₅NO₂)



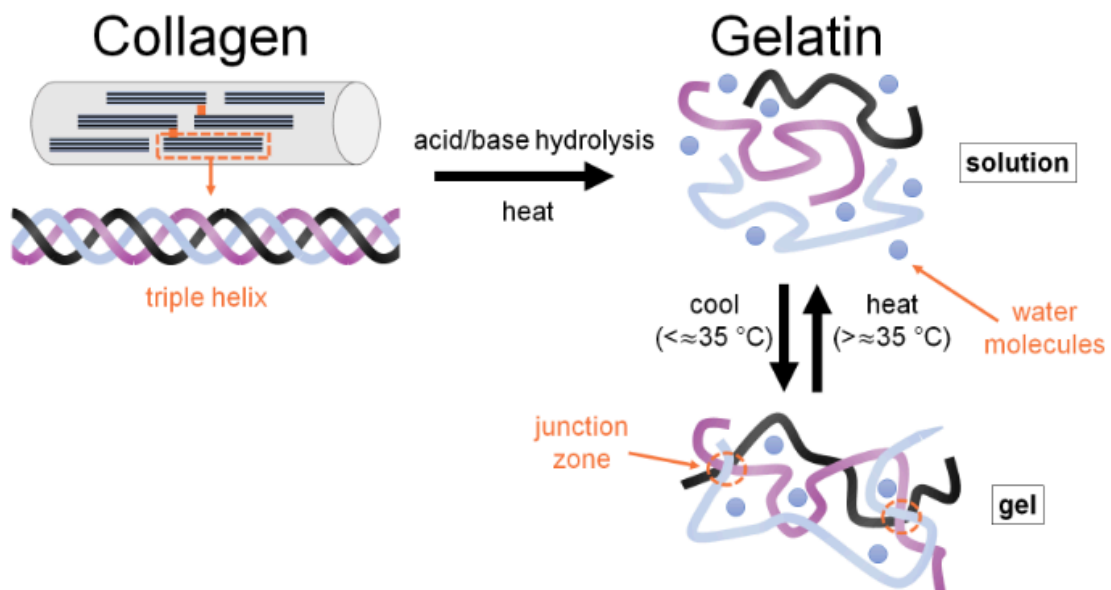
proline(C₅H₉NO₂)



hydroxyproline($C_5H_9NO_3$).

How gelatin is produced

During the production process of gelatin, collagen(Collagen is the most common protein in the body) is extracted from parts of other animals (bones, tendons, skin and connective tissues) and then hydrolysed, which allows the bonds between the individual collagen molecules to be broken, these molecules are isolated, filtered, sterilized then finally dried. In this way, we obtain gelatine with different properties.



The use of Gelatin

Gelatin is widely used in the food industry as a gelling, stabilizing and emulsifying substance for various products. These include, for example, desserts (gives texture, stabilizes foam), dairy products (stabilizes and provides texture), meat products (binds water in meat) etc. It is also extensively used in the beauty industry. It is used widely as an ingredient in cosmetics thanks to its firming, moisturizing and regenerating properties, making it ideal for use in creams, masks, lotions and more.

Likewise it is well suited to the pharmaceutical and laboratory industry. It is used to create many bandages, medicine capsules, and for example fake skin or similar items, and in the laboratory it is used as a chemical reagent.

Gelatin as a supplement

It is most intensively used in the treatment of joint disorders, strengthening hair and nails, thanks to its large number of health-promoting properties. Gelatin nourishes hair, prevents hair loss and brittleness, regenerates and strengthens nails.

Gelatin also has weight loss-supporting properties, supports metabolism, has a positive effect on the digestive system, is very filling and quickly reduces the feeling of hunger.

When used for joint problems, gelatine owes everything to the amino acids involved in the reconstruction and strengthening of connective tissue.

It is used as a supplement and often as a protein substitute by athletes.

Gelatin during the Weight Loss Journey

Gelatin is a high-protein product. Protein makes up about 80% of it and carbohydrates are almost absent in it.

It delivers about 340 calories per 100g, so when added to food in a portion of (15g), it does not provide many calories, which is a very positive aspect for people trying to lose weight.

Gelatin substitutes

Gelatin is extracted from animal parts that is the reason why many people choose to use a more organic and vegan substitutes

Such substitutes are:

-AgarAgar- seaweed powder (used in laboratories for nutrient solutions)

-Carrageenan - extracted from seaweed

-Xanthan gum - a polysaccharide made from monosaccharides

-Konjac- extracted from the asian plant (Amorphophallus konjac)

-Pectin - plant sugar obtained from fruit



agar agar in use



konjac plant



pectin

Interesting facts about gelatin

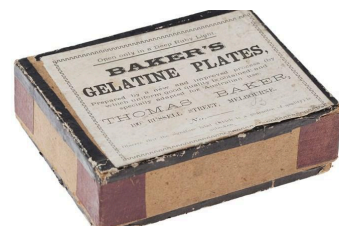
-Gelatin as a food additive is marked as E441

-It treats hypovolaemia (insufficient blood supply) and hypotension (small blood pressure)

- Paintball bullets are surrounded by a shell, of which gelatin is a major component

- Gelatin is used in the production of artificial materials, e.g. silk, and printing inks

- Gelatin was used in the manufacturing process of photographic plates at the turn of the 20th century.



Now I will carry out some tests to check the validity of my hypothesis. I will mix gelatine with different amounts of water and then check the setting time and texture of each. This knowledge would be very helpful during cooking looking for good structure of dessert or during preparing a face mask by myself mixing ingredients and looking for good amount.

Laboratory Test

I made this Test to see if the amount of water makes a difference to the setting time and the structure of gelatine. I conducted this test at home.

What we need:

Equipment:

- a pot
- 5 containers
- bowl
- mixing device
- spatula
- thermometer
- measuring cups
- kitchen weight

Reagents:

- water
- gelatin (6x15 grams)

-The room temperature during whole experiment was 21,5°C

Course of the Test

1. I weighed out the gelatin into six (15 grams) portions
2. I measured out 1.5 liters of water into a pot with measuring cups
3. I heated the water to 60°C
4. Maintaining this temperature I poured the gelatin into the water
5. I stirred this mixture until the gelatin was completely dissolved
6. Poured dissolved gelatin into a bowl labeled "1.5 L"
7. Then I repeated the process with different amounts of water, more precisely "1L", "500ml", "300ml", "150ml," "100ml" adding to each one portion of gelatin (15 grams) and poured to 5 different containers
8. After finishing each water and gelatin mixture I turned on the timer and measured the setting time

9. I checked every 30 minutes if gelatine was solidified and wrote down the time when each of them was ready
10. After all gelatin mixtures were solidified I gently checked their structure with a spatula
11. I repeated this process three times
12. I wrote down all the information and results

Results of the test

Table 1. Time for gelatin to set

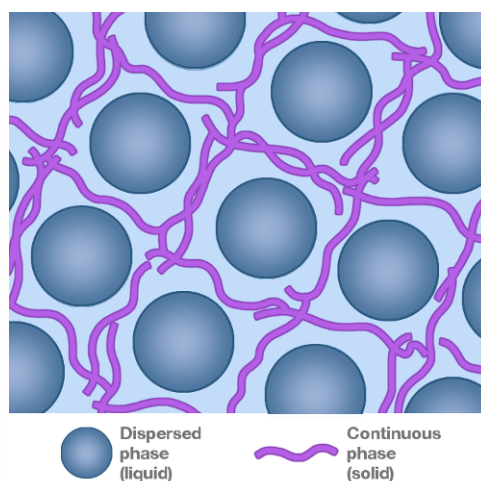
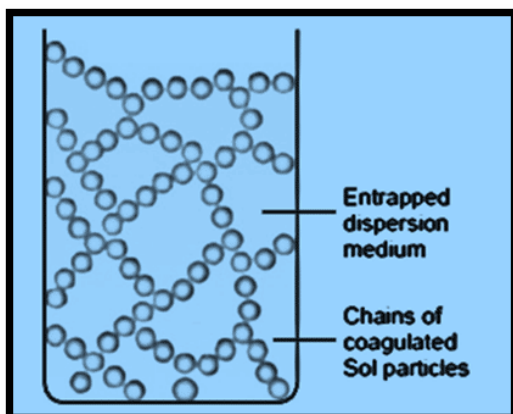
Quantity of water	beginning of test	end of the test	total time
1,5 litre	from 17:50	to 08:25 (the next day)	14 hours 35 minutes
1 litre	from 18:04	to 03:07 (the next day)	9 hours 3 minutes
500 milliliters	from 18:11	to 23:01	4 hours 50 minutes
300 milliliters	from 18:24	to 21:15	2 hours 51 minutes
150 milliliters	from 18:29	to 20:12	1 hour 43 minutes
100 milliliters	from 18:33	to 19:42	1 hour 9 minutes

Table 2. Structure Of Gelatin

Quantity of water	describing structure
1,5 litre	it has structure of jellish water like slime, very shaky
1 litre	really soft jelly structure and really shaky
500 milliliters	stable(not shaky) soft jelly structure
300 milliliters	hard jelly structure and a little bit shaky
150 milliliters	really hard gum structure but more shaky
100 milliliters	really hard, not shaky and really similar to the structure of gum

How the amount of water influence gelatin

The quantity of water matters, because the gelatin in water acts as a network of long, entangled molecules. They provide the gelatin with water its structure and elasticity. When the amount of water is increased, the gelatin molecules become more dispersed in water and less closely packed, this reduces the strength of the hydrogen bonds between molecules and makes the gelatin with water really soft and shaky. We could observe that during checking gelatin samples with different amounts of water.



Conclusion

Analyzing the Test we could see that the smaller the amount of water, the shorter the solidification time and the harder structure of the mixture. The time of the biggest quantity of water was 14h 35 min, I was very waterish jelly and soft structure but for the smallest quantity of water the setting time was 1h 9 min with very hard structure. Looking at the results of different quantities of waters with gelatin we can conclude that if the amount of water is matters during setting process of gelatin (the less water, the faster the gelatine mixture solidifies) and its structure (the less water, the harder the gelatin mixture becomes). That's because in larger amounts of water the gelatin molecules are more dispersed from each other so that the intermolecular interactions and especially the hydrogen bonds become weaker and weaker.

Summary

The chemical experiment shows that the less water is used, the more quickly the gelatin sets and that the less water is used the harder the gelatine will become. This answered my hypothesis "Does the amount of water affect the setting time and the structure of gelatin?". I can use this knowledge, for example, when preparing jelly desserts looking for a good structure of them or during making my own cosmetics like face masks or gel eye pads.

During This Project I learned Many interesting things about gelatin, its properties, how it is used, its health benefits and how the gelling process works. It was pretty interesting experience.

Photos:

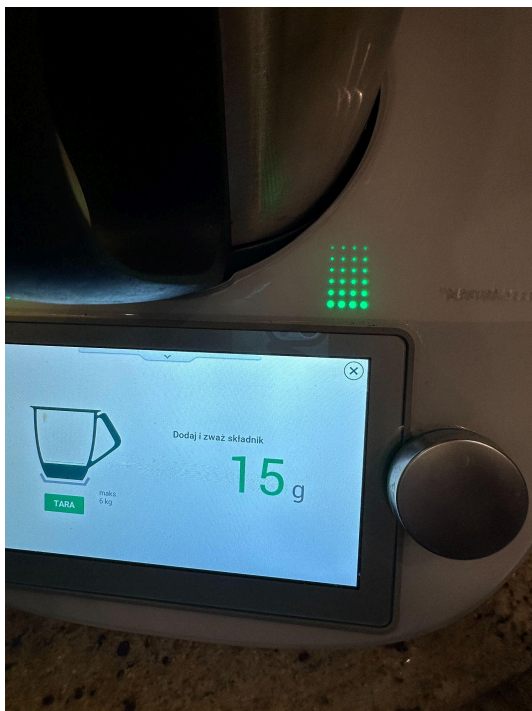
Captioned photos I took during the experiment

Equipment and reagents I needed for Test





measuring
out 15 grams
of gelatine



measuring
out 15 grams
of gelatine



**6 portions
each of them
(15 grams)**





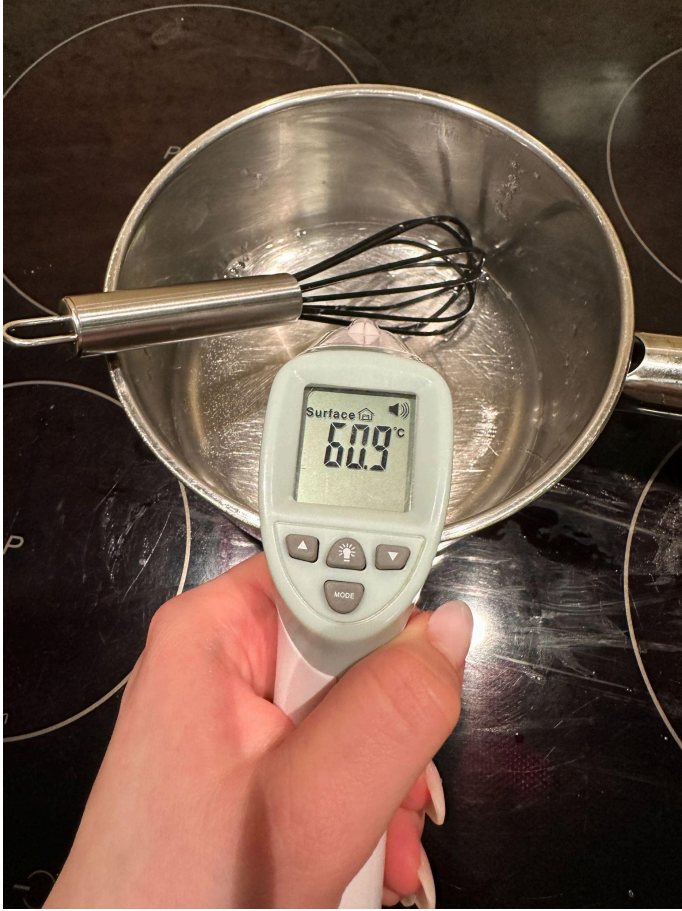
preparing



**measuring
the right
amount of
water**



measuring
the right
amount of
water



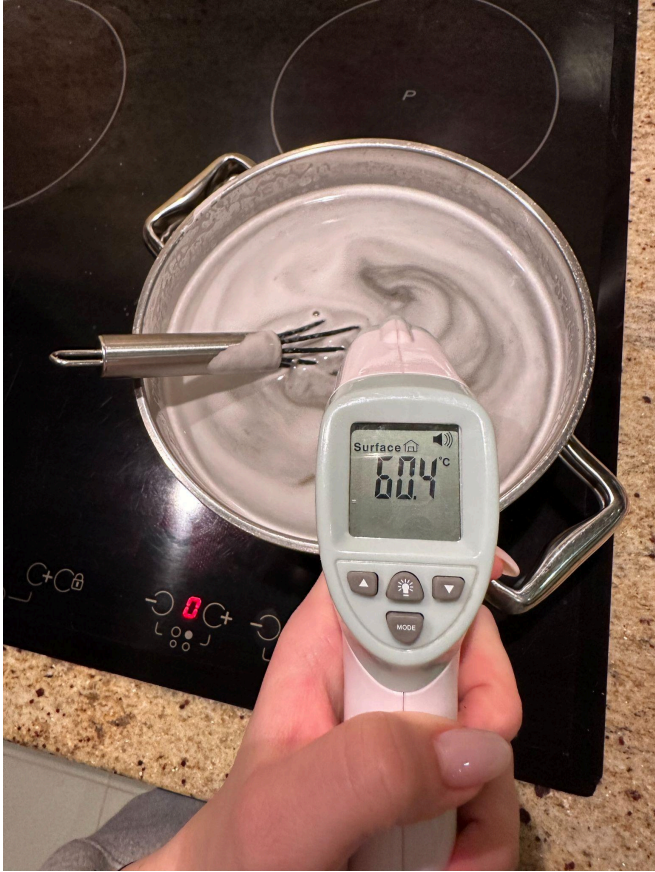
**heating
water to
around 60
degrees**



**pouring
gelatin into
water**



**dissolving
gelatin in
water**



**maintaining
a
temperature
of around 60
degrees**



**Pouring
mixture into
a container**



Pouring 300 ml of the mixture into a container



Pouring 500 ml of the mixture into a container



ready mixtures



ready mixtures (100ml, 150ml)



ready
mixtures
(300ml,500ml
)



Structure of
100ml
after setting



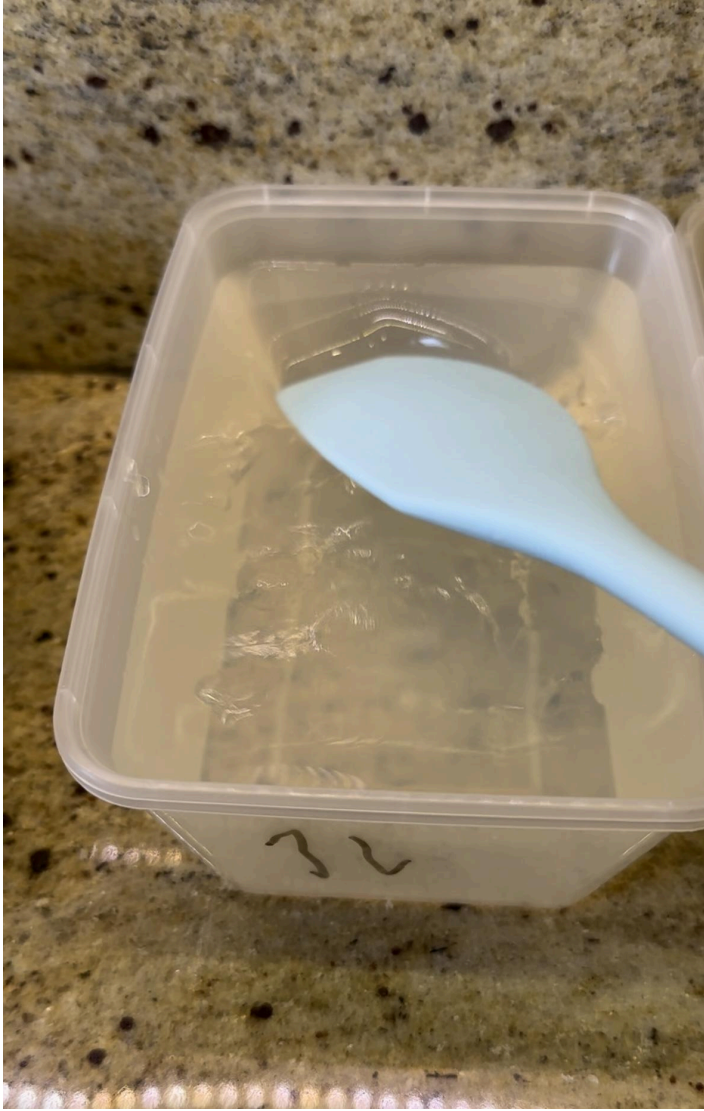
**Structure of
150ml
after setting**



**Structure of
300ml
after setting**



**Structure of
500ml
after setting**



**Structure of
1 L
after setting**



**Structure of
1,5 L
after setting**

Biography:

1. https://sklep.mlynoliwski.pl/_blog/162-Zelatyna_i_hydrolizat_zelatynowy:_zrozumiec_roznice_i_zastosowania.html
2. <https://fit.poradnikzdrowie.pl/diety-i-zywienie/co-jesz/zelatyna-wlasciwosci-i-zastosowanie-jak-zrobic-zelatyne-aa-3iyg-zQ6t-DVru.html#zelatyna-wlasciwosci-i-zastosowanie>
3. <https://www.odzywianie.info.pl/przydatne-informacje/artykuly/art,wszystko-o-zelatynie.html>
4. <https://jawo2008.pl/blog/zelatyna-spozywcza-z-czego-jest-zrobiona.html>
5. <https://pl.wikipedia.org/wiki/%C5%BBelatyna>
6. <https://www.medonet.pl/zdrowie/zdrowie-dla-kazdego,zelatyna-na-stawy---w-lasciwosci--dzialanie--jak-przygotowac,artykul,1733452.html>

7. <https://www.quora.com/How-does-the-amount-of-water-in-jelly-affect-its-elasticity>
8. <https://en.wikipedia.org/wiki/Glycin>
9. <https://en.wikipedia.org/wiki/Proline>
10. <https://pl.wikipedia.org/wiki/Hydroksyprolina>
11. <https://chembam.com/resources-for-students/the-chemistry-of/gelatin/>
12. <https://www.hsph.harvard.edu/nutritionsource/collagen/>
13. <https://my.clevelandclinic.org/health/articles/23089-collagen>
14. <https://chat.openai.com/>