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Experimental and Theoretical Study on the Extraction of Keratin from Human Hair

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Abstract

Background: this is one of the many types of Protein that have been produced in response to the universal demand for the protein.

Objective: highly purified and convert into a high percentage of protein

Keywords: Soy oil is extracted, then leftover material is utilised to create isolate proteins.

Introduction

Sourced from Porcine/ovine hides and hair, hydrolysed keratin protein carefully monitored during its manufacture to ensure the lowest possible odour and a low ash. Keratin is distinct from other proteins in that it is rich in cysteine (a sulphur-containing amino acid) giving keratin a unique strength and protective quality. pH value: 4.0-7.0. Contains 30-34% of protein. Preserved with butylene glycol, phenoxyethanol, and ethylhexylglycerin. Clear amber liquid. Characteristic odour. Soluble in water.

- Revitalizes the hairs natural protective layer and rebuilds tensile strength
- Returns elasticity and reduces breakage
- Reduces hair damage from harsh chemicals
- Acts also as a protective care substance on the skin

Say yes to gorgeous hair with the Skin Secrets Hair Spa which is ideal for dry and damaged hair. It fights against the five visible signs of damaged hair; hair fall, dryness, roughness, dullness, and split ends. Argan Oil present in the mask contains Vitamin E which helps smooth frayed hair shafts and seals split ends while the omega fatty acids work to strengthen your hair. It has pro-keratin complex which leaves hair feeling soft, smooth and shiny. How to use - Apply the Keratin Hair Mask to shampooed, towel-dried hair. Distribute evenly and massage throroughly into hair and scalp in a downwards motion for 2-3 minutes. Comb and leave for 5-7 minute using a steamer or warm towel. Rinse thoroughly with lukewarm water. For best results, use once or twice a week as part of your hair care routine.

Keratin is the type of protein that makes up your hair, skin, and nails. Keratin can also be found in your internal organs and glands. Keratin is a protective protein, less prone to scratching or tearing than other types of cells your body produces. Keratin can be derived from the feathers, horns, and wool of different animals and used as an ingredient in hair cosmetics. Since keratin is the structural building block of your hair, some people believe that keratin supplements, products, and treatments can help strengthen your hair and make it look healthier. People who use keratin on their hair report that their hair is smoother and easier to manage as a result. The effects vary greatly depending on whether your hair is healthy to begin with, what the natural thickness of your hair is, and what kind of keratin treatment you use. Keratin works by smoothing down the cells that overlap to form your hair strands. The layers of cells, called the hair cuticle, theoretically absorb the keratin, resulting in hair that looks full and glossy. Keratin also claims to make curly hair less frizzy, easier to style, and straighter in appearance.

Sometimes called the Brazilian keratin treatment, this time-intensive method of using keratin involves several steps. First, a cream that contains formaldehyde is applied to your hair before it's blown dry and straightened in a salon. Once the treatment is applied, you're instructed to keep your hair dry for several days. When you visit the salon to have the chemicals washed out, another treatment is applied to "set" the straightening effect. This treatment claims to last for 12 weeks.

Material and method

Chemicals:

All chemicals used were of analytical grade this are the given below,

Sr. No.	Chemical's / Reagent	Make	Purity %	Molecular Formula	Molecular Wight
1.	Sodium Hydroxide Pellets	Qualigens	97%	NaOH	40.0
2.	Copper Sulphate	Qualigens	98.5%	$CuSO_45H_2O$	249.68
3.	Potassium sulphate	Qualigens	99.10%	K_2SO_4	174.26
4.	Hydrochloric acid	Qualigens	35.37%	HCl	36.46
5.	0.1N Sulphuric acid Ampoules	Qualigens	99.90%	-	-

6.	Distilled Water	Qualigens	99.10%	H_2O	18.02
7.	Bromocresol green indicator	Qualigens	98%	$C_{21}H_{14}Br_4O_5S$	698.04
8.	Methyl red indicator	Qualigens	98.20%	$C_{15}H_{15}N_3O_2$	269.30
9.	Boric Acid	Qualigens	96.30%	H_3BO_3	61.83
10.	Hair	Local market (salon)	-	C45%,O28%,N15%, H7%,S5%	50kDa
11.	Hydrogen Peroxide	Qualigens	40%	H_2O_2	34.01

Equipment's:

pH Meter, Kjeldahl's Assembly, Analytical Balance, Volumetric Flasks, Volumetric Pipettes, Bukner funnel , Conical flask, Beaker, Timer (stopwatch), Whatman 42 no. filter paper, Vacuum pump, filtration assembly with vacuum pump, Homogenizer

Hair Source:

After bringing the hair from the nearest salon and shampooing it, this process was repeated 4 times, then the hair was dried in sunlight and then kept in an airtight bag.

Purification:

1. collected hair wt. 1 kg and water 8 lit. set the pH 6.7
2. Addition 2 % of Keratinase enzyme.
3. Provide heating 60ºC
4. Maintain heating 15 Hr.
5. Increase the temp. 95ºC for 5 min.
6. Cool down about 65ºC and filter it with the help of bukner funnel , Whatman filter paper no . 42 and vacuum pump.
7. Collect the all filter solution and addition of 1.5 % of 40% hydrogen peroxide for the purpose of decolourization. Then its as it is a room temp. for 8 Hr.
8. Addition of lipase enzyme 0.4 %. (neutralization of hydrogen peroxide)
9. Evaporate the solution
10. Spray drying

Enzymatic digest sol^{n} H_2O_2 Treatment Sol^{n} charcoal treatment sol^{n}

Assay of Protein:

Principle of the Kjeldahl Method

The principle of the Kjeldahl method is based on the digestion of the sample in concentrated sulfuric acid (H_2SO_4), which converts the nitrogen present in the sample (as organic nitrogen) into ammonium sulfate $(NH_4)_2SO_4$. After digestion, ammonia is distilled from the solution and quantified by titration with a standard acid solution.

Steps Involved in the Old Kjeldahl Method

1. Digestion

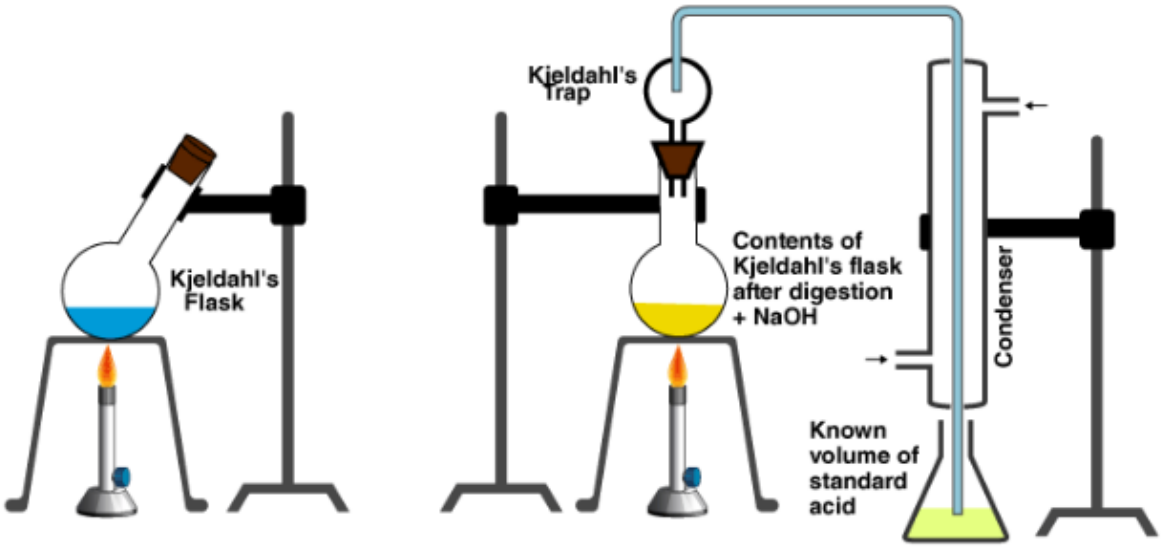
- **Purpose**: To convert organic nitrogen in the sample into ammonium ion (NH_4^+).
- **Procedure**:
- Weigh a known amount of the sample (usually between 0.25 and 035 g) and place it in a Kjeldahl digestion flask.
- Add concentrated sulfuric acid (H_2SO_4) (about 20-30 mL) to the flask.
- Add a catalyst such as potassium sulfate (K_2SO_4) and copper sulfate ($CuSO_4$)) to speed up the reaction.
- Heat the flask gently. The sulfuric acid will break down the organic material, and nitrogen will be converted into ammonium sulfate.
- This digestion process can take 1 to 2 hours. The mixture turns clear, which indicates that the organic matter has been successfully digested.

2. Neutralization and Distillation

Purpose: To convert the ammonium ion (NH_4^+) to ammonia gas (NH_3) and distill it into a receiving solution.

Procedure:

- After digestion is complete, cool the flask and dilute the solution with water.
- Add a strong base, usually **sodium hydroxide (NaOH)**, to make the solution alkaline. The ammonia (NH_3) gas is liberated when ammonium sulfate reacts with the alkali:
- (NH4)2SO4+2NaOH→2NH3+Na2SO4+2H2O$(NH_4)_2SO_4 + 2\ NaOH \rightarrow 2\ NH_3 + Na_2SO_4 + 2\ H_2O$(NH4)2SO4+2NaOH→2NH3+Na2SO4+2H2O
- The ammonia gas (NH_3) is distilled by heating the solution. The ammonia gas is passed into a receiving solution, typically a known concentration of **boric acid (H_3BO_3)** in water, which absorbs the ammonia.



1. Digestion **2. Neutralization and Distillation**

3. Titration

Purpose: To quantify the amount of ammonia (NH_3) captured in the receiving solution, which corresponds to the nitrogen content of the sample.

Procedure:

- The ammonia solution (from step 2) is then titrated with a standard solution of a strong acid, typically **hydrochloric acid (HCl)** or **sulfuric acid (H_2SO_4)**.
- A few drops of an appropriate pH indicator, such as **methyl red** or **bromocresol green**, are used to monitor the endpoint.
- The amount of acid required to neutralize the ammonia solution is directly related to the amount of nitrogen present in the sample.

4. method of Protein content calculation

The nitrogen content is determined by the volume of acid used in the titration. The formula for calculating the nitrogen content is:

$$\text{Nitrogen Content (g)} = \frac{0.14 \left[\frac{(\text{Volume of Acid} \times \text{Normality of Acid})}{0.1} - \text{Burette Reding} \right]}{\text{Sample weight(g)}}$$

Where:

- **Equivalency factor**: This factor depends on the type of acid used for titration. For HCl, it is typically 1, but it may vary depending on the acid and its concentration.
- **Normality of acid**: The normality of the titrant (HCl or other acid) is typically expressed in equivalents per liter.

Once the nitrogen content is determined, you can estimate the **protein content** by using the **N × 6.25** factor, assuming that protein contains approximately 16% nitrogen. The conversion factor may vary depending on the type of protein being measured.

Result of isolate proteins:

- If 0.3 grams of sample were used, and the titration required 40 mL of 0.1 N HCl for neutralization, the nitrogen content can be calculated as:

$$\text{Nitrogen content} = \frac{0.14 \left[\frac{(40 \times 0.1020\ \text{N})}{0.1} - 6.2\ \text{ml} \right]}{0.3\ \text{g}} = 16.14\ \%.$$

To estimate the protein content:

Protein content=16.14 %×6.25=100.91 % of protein

Conclusion

This study provides significant insights into the relationship between soy protein isolates and the textural properties of texturized vegetable protein (TVP), contributing to the growing body of research on plant-based meat analogs. Through the careful purification of defatted soy flower and the application of Kjeldahl's method for precise nitrogen analysis, we have successfully quantified the protein content, demonstrating that soy protein isolates can consistently achieve over 90% protein concentration.

Our findings confirm that the protein composition, particularly the balance between 7S and 11S globulins, plays a crucial role in determining the hydration, gelling, and emulsifying properties of TVP. These properties are essential for improving the texture and functional characteristics of plant-based protein products, making them viable alternatives to traditional animal-based meats. The interactions between soy proteins, influenced by factors such as pH, extrusion conditions, and the presence of additives like L-cysteine, were shown to significantly affect the textural integrity of TVP, offering important implications for both food science and the growing plant-based food industry.

Additionally, our study highlights the importance of efficient protein isolation techniques, which not only enhance the functional properties of soy proteins but also maximize protein yields, thus making plant-based protein more accessible for use in a variety of food products. This work underscores the potential of soy protein isolate as a sustainable, high-quality ingredient for developing healthy, protein-rich food products that can help meet the dietary needs of a growing global population, particularly among vegetarians, vegans, and those seeking to reduce their consumption of animal-derived foods.

In conclusion, the research not only advances our understanding of the molecular basis of soy protein functionality but also paves the way for the future optimization of soy-based meat alternatives. The Kjeldahl method, while classic, remains a fundamental tool for nitrogen and protein analysis, contributing to the development of more efficient and sustainable food production methods. Further studies are needed to explore additional protein isolates and their interaction with other plant-based ingredients to enhance the overall quality and consumer acceptance of texturized vegetable proteins.