Impact of Cooking Methods on Nutritional Content of Shrimp and Tofu

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Abstract

Food is the primary source of energy and nutrients required for human survival. Food can be consumed raw and cooked, too. Food is essential for the growth of an organism as it contains proteins, carbohydrates, fats, vitamins, and minerals as nutrients. Proteins are large biomolecules made up of one or more amino acid chains. Within living things, proteins carry out a wide range of functions. Carbohydrates are sugar molecules that the human body converts to glucose. The body's tissues, organs, and cells primarily utilize glucose as energy. Fats are a primary storage form of energy in the body, which act as a fuel source. Thus, it is essential to include a moderate amount of fats in a balanced diet. The current study highlights the effect of boiling and sauteing on the carbohydrate, protein, and fat content of shrimp and tofu. Protein estimation was conducted using the Kjeldahl method, Carbohydrate estimation using the moisture determination method, and fat estimation using the Soxhlet extraction method. It was observed that boiling the shrimp showed a substantial decrease in carbohydrates (<78.7%), fats (<55.84%), and protein (<28.65%) content. Similarly, boiling tofu also showed a substantial decrease in the carbohydrate (<44.14%) and protein (<4.44%) content. However, the content of fats after boiling the tofu had increased (>94.11%). Contarily, for both the samples, sauteing increased the content of fats, carbohydrates, and protein, which could be due to the oil used for cooking.

Keywords: Nutrients, cooking methods, shrimp, tofu.

Background

- **Importance of Nutrition:** Nutrition is crucial for health as it provides energy which allows our bodies to perform all the necessary biological processes. Nutrition also strengthens immune systems which helps humans battle chronic diseases such as diabetes, heart disease, and cancer.
- **Components of a Balanced Diet:** As per the NHS A balanced diet comprises - meals based on high fibre starchy foods like potatoes, bread, rice or pasta, 5 portions of a variety of fruit and vegetables every day, diary or dairy components, protein in the form of meat, fish, eggs, pulses, beans, etc, unsaturated fats in small amounts and plenty of fluids like water.
- **Cooking Methods and Nutrient Retention:** Different cooking methods affect nutrient retention differently. While cooking some foods is necessary for safety, in some cases, cooking decrease nutrient density. In general, dry heat cooking methods like frying may increase fat content, while moist heat methods retain nutrients better.
- **Nutritional Content of Shrimp:** Shrimp is nutritious as it is low in calories and high in protein, healthy fats, vitamins, and minerals. Despite its high cholesterol content, it contains omega-3 fatty acids that benefit cardiovascular health.
- **Health Benefits of Tofu:** Tofu is low in calories yet rich in protein, fat, vitamins, and minerals. Tofu does however contain antinutrients, such as trypsin inhibitors and phytates the levels of which can be reduced by soaking, sprouting, or fermenting soybeans before making tofu. Tofu also contains isoflavones which is believed to be the leading cause of its health benefits.

Research Question & Hypothesis

Research Question → How do the different cooking techniques, boiling and sauteing influence the nutritional content of Shrimp and Tofu?

Alternate Hypothesis→ There is a measurable impact of boiling and sauteing on the nutritional content of shrimp and tofu.

Null Hypothesis → There is no measurable impact of boiling and sauteing on the nutritional content of shrimp and tofu.

Materials Used

- **Samples :**
  - 100g sauteed shrimp
  - 100g of boiled shrimp
  - 100g of sauteed tofu
  - 100g of boiled tofu
- **Miscellaneous :**
  - 2 tbsp sesame oil
  - Water
  - Cook top
  - Pan for sauteing/Vessel for boiling

Raw Shrimp

Raw Tofu

Methodology

- Quantitative analysis of all the samples was conducted using standard protocols as mentioned below:

Nutrient	Method Used
Carbohydrate	IS 1656
Fat	AOAC- 922.06
Protein	IS 7219

Table 1: The Standard procedure used for testing.

Determination of Total Carbohydrates

Total carbohydrates are calculated as follows after determining the percentage of moisture,total protein, fat and total ash.

Total carbohydrates including sucrose, dextrose and dextrins, maltose or Lactose, percent by mass = 100 - (A + B + C + D)

Where,

- A =percent by mass, of moisture
- B = percent by mass of total protein
- C = percent by mass, of fat, and
- D = total ash, percent by mass

Determination of Total Fat

Total Fat is calculated as follows after determining the sample weight, weight of empty flask, weight of empty flask + residue measurement 1, and weight of empty flask + residue measurement 2.

Total fat percent by mass = (W3-W1)*100

Where,

- W3 = weight of empty flask + residue measurement 2.
- W1 = weight of empty flask

Determination of Total Protein

Total Protein is calculated as follows after determining the weight of the sample, Titre volume for blank, Titre volume for sample, Net Volume, Factor, and Normality of 0.1N- NaOH

Total protein percent by mass = V*N*F*14.00*100

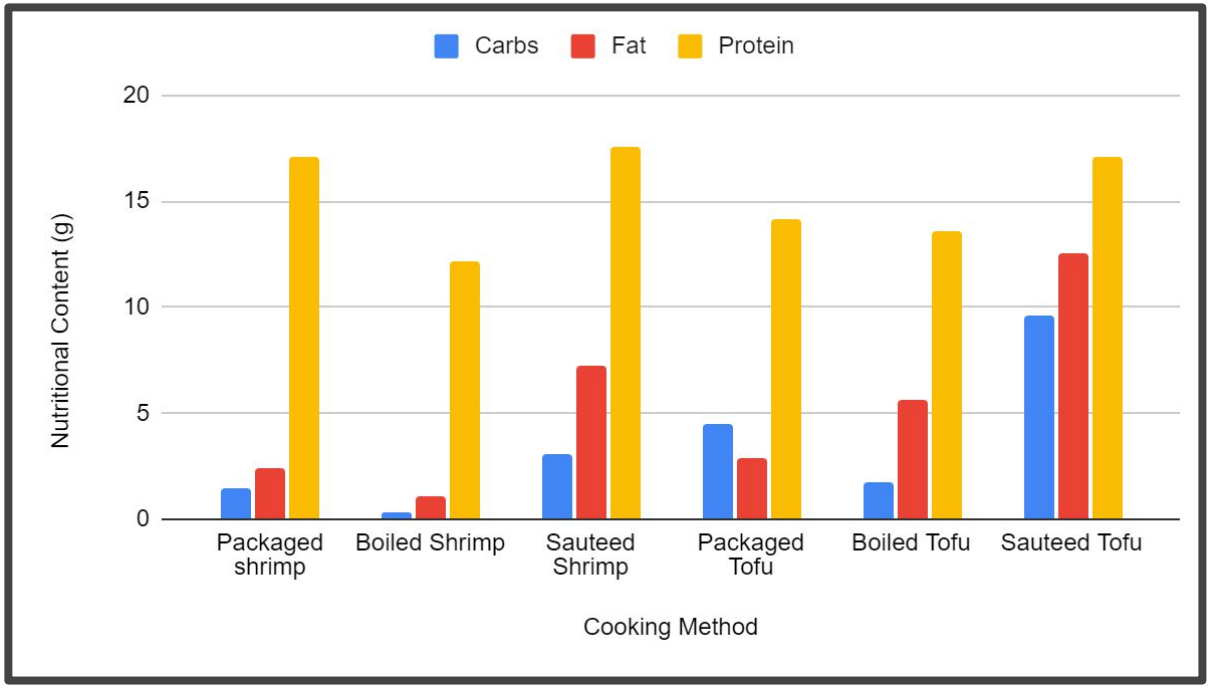
Where,

- V = Net volume
- N = Normality of 0.1N- NaOH
- F = Factor

Results

Nutrient	Packaged shrimp	Boiled Shrimp	Sauteed Shrimp	Packaged Tofu	Boiled Tofu	Sauteed Tofu
Carbohydrate	1.5	0.32	3.06	4.5	1.79	9.64
Fat	2.4	1.06	7.21	2.89	5.61	12.56
Protein	17.1	12.2	17.56	14.19	13.56	17.06

Table 2: The nutritional content of Shrimp and Tofu before & after boiling and Sauteing



Graph 1: Pre and post cooking nutritional Values of Shrimp and Tofu.

Discussion

- Boiling the shrimp showed a substantial decrease in carbohydrates (<78.7%), fats (<55.84%), and protein (<28.65%) content. Similarly, boiling tofu also showed a substantial decrease in the carbohydrate (<44.14%) and protein (<4.44%) content.
- Here the outlier was the fat content in boiled tofu. The fat content had increased (>94.11%) contrary to the decrease in the boiled shrimp sample.
- For both shrimp & tofu sauteing increased the content of all three nutrients i.e. fats, carbohydrates, and protein.
- This increase could be attributed to the use of 1 tbsp sesame oil whilst cooking both shrimp & tofu.

Effect of Sauteing and Boiling on the Fats content

- **Sauteing:**
  - **Shrimp:** Shrimp naturally contain some fats, primarily in the form of omega-3 and omega-6 fatty acids. Sautéing shrimp in oil adds additional fats to it.The type of oil used will also influence the fatty acid profile of the dish.
  - **Tofu:** Tofu is relatively low in fat, but sautéing it in oil will increase its fat content as it absorbs some of the oil during cooking. The type of oil used will also influence the fatty acid profile of the dish.
- **Boiling:**
  - **Shrimp:** Boiling shrimp can lead to the loss of some fat content, especially if the shrimp is boiled without its shell. The fats in shrimp are susceptible to heat and can melt and leach out into the boiling water.
  - **Tofu:** Tofu is relatively high in fat, primarily unsaturated fats. Boiling tofu may cause some fat loss.

Effect of Sauteing and Boiling on the Carbohydrates content

- **Sauteing**:
  - **Shrimp:** Shrimp are very low in carbohydrates, so there is minimal impact on their carbohydrate content when sautéed.
  - **Tofu:** Tofu contains a small amount of carbohydrates, primarily in the form of sugars and fiber. Sautéing tofu may slightly reduce its water content, concentrating the carbohydrates, but the overall impact on carbohydrate content is minimal.
- **Boiling:**
  - **Shrimp:** Shrimp contains minimal carbohydrates, primarily in the form of glycogen. Boiling may not significantly affect the carbohydrate content of shrimp.
  - **Tofu:** Tofu contains carbohydrates in the form of starch. Boiling tofu may soften the texture and increase the digestibility of carbohydrates, but it is unlikely to significantly alter the carbohydrate content.

Effect of Sauteing and Boiling on the Protein content

- **Sauteing:**
  - **Shrimp:** Shrimp are a rich source of protein. Sautéing shrimp may cause some denaturation of the proteins due to the high heat, but the overall protein content remains relatively unchanged.
  - **Tofu:** Tofu is a plant-based protein source. While some protein denaturation may occur during cooking, the protein content of tofu remains largely intact.
- **Boiling**
  - **Shrimp:**Protein is a major component of shrimp. Boiling can cause denaturation of proteins, altering their structure and potentially making them more digestible. However, excessive boiling can lead to protein degradation and loss.
  - **Tofu:**Tofu is rich in protein, making it a valuable source of plant-based protein. Boiling tofu can cause some denaturation of proteins, similar to what occurs with shrimp. However, tofu proteins are generally more stable than those in animal products, so protein loss may be minimal.

Conclusion

- Cooking methods like boiling, and sauteing sometimes deplete essential nutrients.
- This research is was undertaken to identify which cooking methods are the ones that lead to losses of essential nutrients.
- From the discussion of the results it can be concluded that the alternate hypothesis is true, there is a measurable impact of boiling and sauteing on the nutritional content of shrimp and tofu as proved by the results of the paper.
- The current study involves only using Shrimp and Tofu, however for a holistic conclusion it will be required to study more food materials (Vegetables + Meat based).
- More nutrients like Vitamins, Minerals content present in food can be investigated.
- A potential research question for future study could be to investigate the effect of frying, baking, microwaving , etc. on different food materials.

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