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REPORT

Title: Application of sous-vide cooking to beef meat for a central kitchen delivering to hospitals

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ABSTRACT

This study examines the application of sous vide technology to beef meat for delivery to central kitchens in hospitals in Uzbekistan. With an average hospital stay of 5.5 days, the study addresses the need for safe, nutritious and personalized nutrition in a hospital setting. Sous vide cooking, characterized by precise temperature control and long, low-temperature cooking, is examined in comparison to traditional cooking methods.

The benefits of sous vide cooking include improved flavor, increased food safety, and precise temperature control. Selecting beef flank as the primary meat cut ensures that the patient's dietary needs are met. The research includes microbiological testing, instrumental texture analysis and adherence to HACCP principles to ensure the safety and quality of cooked meat.

Comparisons are made with traditional cooking methods, microwave heating, and prepackaged hospital meals to highlight the potential superiority of sous vide cooking. This work demonstrates the innovative use of sous vide technology as a means to revolutionize hospital food service, providing the basis for safe, nutritious, and high-quality nutrition for patients.

INTRODUCTION

In Uzbekistan, most hospitals are acute-care hospitals, meaning that the treatment is short-term. The average numbers of days that the patient spends in a hospital is 5.5.

As the lengths of patient's stay is relatively short, hospitals food service uses a restaurant-style menu or one-week cycle menu.

And the meals should be modified to meet dietary requirements such as a low-sodium diet for someone who has high-blood pressure or a carbohydrate-controlled diet for someone with diabetes.

So, we offer using completely new method named sous-vide cooking to food service in hospital which can help us to achieve perfect safety.

Delivering sous vide beef from a centralized kitchen to hospitals has significant benefits. Precise control of sous vide cooking temperatures ensures consistent, safe and tender beef in all batches. This method meets hospital hygiene standards and produces pasteurized and flavorful meat suitable for a variety of patient needs [1]. Operational efficiency is enhanced by optimizing centralized kitchens, optimizing resource utilization and minimizing waste. The versatility of sous vide allows for a variety of cuts and dietary requirements to be accommodated, which is critical in a hospital setting. Adherence to Hazard Analysis Critical

Control Points (HACCP) ensures strict safety protocols and traceability, as well as compliance with hospital food safety standards. Additionally, sous vide cooking preserves nutrients and flavor, helping to deliver nutritious and delicious meals to hospital patients. Overall, central kitchen delivery with sous vide cooking is a suitable and cost-effective approach for efficient, safe and quality healthcare food service.

HISTORY OF SOUS-VIDE COOKING

The origin of sous-vide cooking can be tracked back to the late 18th century but the method was not popular or practiced. The French engineer and inventor, Sir Benjamin Thompson, also known as Count Rumford, conducted experiments in the 1790s on the effects of heat on various substances, including meat [2].

He discovered that by cooking meat at a low temperature for an extended period, it became tender and retained its natural juices.

COMPARING SOUS-VIDE COOKING WITH OTHER COOKING METHODS OR TRADITIONAL APPROACHES TO HOSPITAL NUTRITION

Sous-Vide vs. Boiling:

Sous-vide cooking retains the natural juices and flavors of the meat due to its sealed, low-temperature cooking process, while boiling may result in nutrient loss and a less appealing texture.

Boiling is less precise and can lead to overcooking, which can negatively impact the texture and flavor of the meat, whereas sous-vide cooking ensures consistent results.

Sous-Vide vs. Microwaving:

Sous-vide cooking delivers superior texture and taste as compared to microwaving, which can often result in uneven heating, rubbery textures, and loss of moisture.

Microwaving can cause localized overheating, potentially leading to the formation of hot spots that can be a safety concern, whereas sous-vide maintains uniform cooking throughout.

Sous-Vide vs. Pre-Packaged Hospital Meals:

Pre-packaged hospital meals are often subject to long shelf lives and processing methods that can degrade the quality of the food over time, while sous-vide cooking provides freshly prepared, high-quality meals on-site.

Sous-vide cooking allows for greater customization of meals to meet specific dietary needs, such as low-sodium or carbohydrate-controlled diets, which may not be achievable with pre-packaged options.

Sous-Vide vs. Conventional Roasting/Baking:

Sous-vide cooking can achieve precise temperature control, ensuring that the meat is cooked to the desired level of doneness without overcooking or drying out, while conventional roasting or baking methods are more prone to inconsistencies in temperature and moisture levels.

Roasting in the oven, either before or after sous-vide cooking of lamb meat, leads to a browner surface and a more intense cooked meat flavor [3].

Traditional roasting or baking may require higher cooking temperatures, which can lead to the formation of potentially harmful compounds, such as acrylamide, while sous-vide cooking can maintain lower, safer cooking temperatures.

Sous-Vide vs. Traditional Dietary Approaches:

Traditional hospital food service approaches often rely on batch cooking or reheating methods that can lead to inconsistent quality, especially for patients with specific dietary requirements, in contrast to sous-vide, which allows precise customization.

Sous-vide cooking's ability to maintain consistent quality and safety for extended periods makes it particularly suitable for patients with short hospital stays, ensuring that each meal meets their dietary needs.

Sous-Vide vs. Common Cooking Techniques in Hospital Kitchens:

Comparing sous-vide with the most commonly used cooking methods in hospital kitchens, such as grilling, sautéing, or steaming, can demonstrate the advantages in terms of tenderness, juiciness, and safety offered by sous-vide cooking.

We selected the best part of beef sirloin from a number of meats for the task. The main reason for this is that lamb causes high blood pressure in older people. Chicken meat is high in salmonella and a bit dry and rabbit meat is expensive, hard to find enough and smelly.

Picture.1. Parts of beef meat

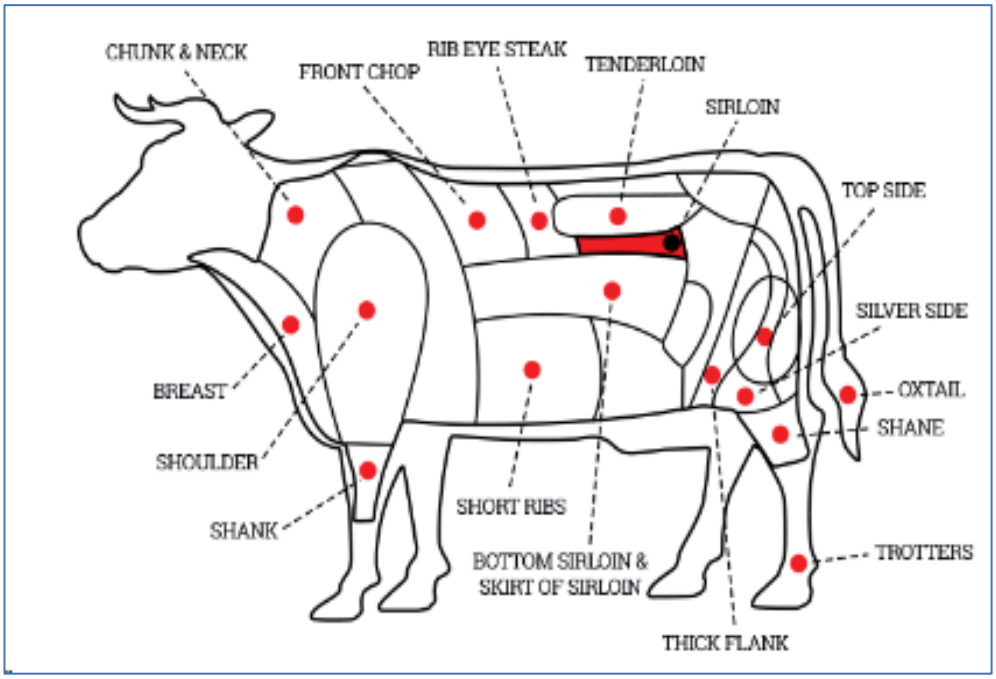
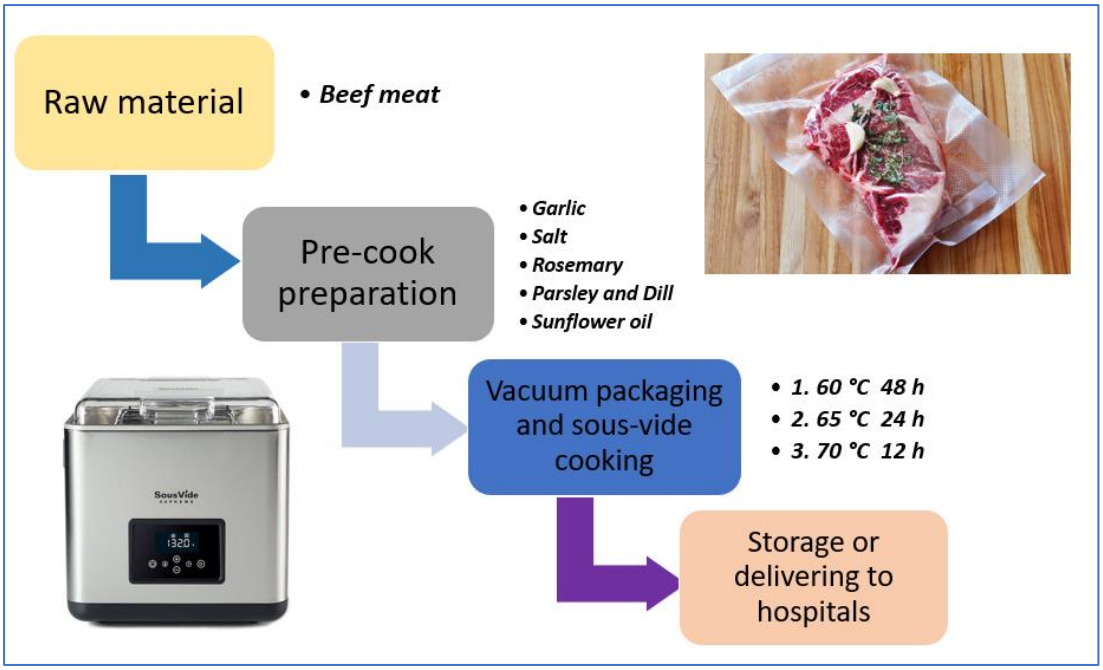


Table.1. Approximate cost parts of beef meat in Uzbek markets (October 2023).

Parts of beef meat	Price (per kg UZS)
Chunk and neck	80 000
Front chop	80 000
Rib eye steak	75 000
Tenderloin	75 000
Sirloin	70 000
Top side	70 000
Silver side	80 000
Oxtail	40 000
Shane	60 000
Trotters	40 000
Thick flank	50 000
Bottom sirloin and skirt of sirloin	70 000
Short ribes	80 000
Shank	80 000
Shoulder	80 000
Breast	60 000

The sirloin is a moderately tender cut located between the short loin and the round. It's more affordable than some premium cuts but still offers good flavor. Sous-vide cooking can enhance its tenderness.

Picture.2. Technological process for sous-vide cooking



DESCRIPTION OF COOKING DESIGNS

60°C for 48 hours:

Cooking beef at 60°C for an extended period of 48 hours is a low and slow approach that promotes the breakdown of collagen in the meat, resulting in an exceptionally tender and melt-in-your-mouth texture. This is particularly beneficial for cuts that are traditionally tougher.

The extended cooking time at a moderate temperature ensures that the beef is pasteurized, making it safe for consumption in a hospital setting. Pasteurization eliminates harmful bacteria and pathogens without compromising the quality of the meat.

The longer cooking time allows for a consistent doneness throughout the entire cut, ensuring that even thicker portions reach the desired temperature without risk of overcooking.

65°C for 24 hours:

This temperature and time combination strikes a balance between tenderness and efficiency. The slightly higher temperature of 65°C accelerates the cooking process compared to the 60°C option, making it suitable for a hospital kitchen where time is a critical factor.

While the cooking time is reduced compared to the 60°C option, 24 hours is still sufficient to achieve a tender and flavorful result. This approach allows for good quality retention while accommodating the demands of a hospital kitchen's workflow.

The 65°C temperature is versatile enough to work well with various cuts of beef, offering a middle-ground option that suits different preferences for doneness.

70°C for 12 hours:

The 70°C temperature, while higher than the other options, allows for a faster cooking time of 12 hours. This is beneficial in a hospital kitchen where efficiency is crucial, and a quicker turnaround time may be required.

The higher temperature provides an extra margin of safety by rapidly pasteurizing the meat, ensuring the destruction of harmful bacteria. This is important in a hospital setting where food safety is a top priority.

The higher temperature can contribute to bolder flavor development in the beef, creating a slightly different taste profile compared to the lower-temperature options.

The three variations offer a range of options to cater to different preferences and constraints in a hospital kitchen. The 60°C option prioritizes maximum tenderness, the 65°C option balances tenderness with efficiency, and the 70°C option emphasizes speed while ensuring safety and flavor development.

We choose the variation of cooking beef at 65°C for 24 hours. Here's a more detailed description of why this option might be a suitable choice:

Cooking beef at 65°C for 24 hours strikes a balance between achieving tenderness and maintaining efficiency. The slightly higher temperature compared to the 60°C option accelerates the breakdown of collagen, resulting in a tender and succulent texture that is still palatable and not overly soft.

The 24-hour cooking time is shorter than the 48-hour option, making it more practical for a hospital kitchen where time management is crucial. This allows for a quicker turnaround without sacrificing the quality and tenderness of the beef.

The 65°C temperature provides a good compromise between flavor development and efficiency. It allows for sufficient time for the meat to absorb and retain flavors while preserving its natural juices, resulting in a delicious and juicy end product.

This temperature is versatile enough to work well with a variety of beef cuts, catering to different preferences for doneness. It offers flexibility in the menu planning for a hospital setting.

While not as prolonged as the 48-hour option, the 24-hour cooking time still ensures pasteurization, eliminating harmful bacteria and pathogens. This is critical in a hospital setting where food safety is a top priority.

The combination of 65°C and 24 hours provides a reliable and consistent level of doneness throughout the beef, ensuring that the meat is both safe to eat and meets the desired taste and texture standards.

The 65°C for 24 hours option aligns well with the operational demands of a hospital kitchen, allowing for efficient planning and execution of meal preparation without compromising on quality.

This option strikes a balance between resource utilization and quality output, making it feasible for a central kitchen delivering to hospitals with varying meal requirements.

Cooking beef at 65°C for 24 hours provides a well-balanced approach, combining tenderness, flavor retention, safety, and efficiency. It offers a practical solution for a hospital kitchen, ensuring that the delivered beef is not only safe but also consistently delicious and of high quality.

Table.2. Approximate cost calculation

№	Raw material and ingredients	Unit	Price per unit (UZS)	Amount in portion	Price per portion (UZS)
1	Beef meat	1 KG	70 000	0,2 KG	14 000
2	Garlic	1 KG	40 000	0,0005 KG	20
3	Rosemary	1 KG	35 000	0,004 KG	140
4	Parslay and Dill	1 KG	20 000	0,006 KG	120
5	Salt	1 KG	6000	0,0005 KG	3
6	Sunflower oil	1 KG	21 000	0,004 KG	84
				Total:	**14 367**

FOOD SAFETY

The quality of cooked meat is a multidimensional characteristic, which is influenced by the characteristics of the meat cut, physicochemical and organoleptic properties, as well as the microbiological safety of the final product.

Literary sources most often refer to certain aspects of the sous vide method: the different quality of meat cuts, for example, the shelf stability of beef cooked at different combinations of temperatures and time.

Microbiological tests

GOST 10444.15-94 Methods for determination of quantity of mesophilic aerobes and facultative anaerobes

The method of determining the number of mesophilic aerobic and facultative-anaerobic microorganisms by sowing into agarised nutrient media is based on sowing the product or dilution of the product suspension into the nutrient media, incubating the sowing, counting all the visible colonies grown [4].

GOST 31747-2012 Methods for detection and quantity determination of coliforms

The number of bacteria contained in 1 cm3 or 1 gram of the product, determined by sowing the product and (or) its dilutions in or on agarised selective-diagnostic medium, counting after incubation at 37 °C typical and atypical colonies and determining the ability of bacteria from these colonies to ferment lactose with gas formation. [5]

GOST 30726-2001 Food-stuffs. Methods for detection and determination of Escherichia coli

Methods of detection and determination of E. coli are based on sowing a certain amount of the product and (or) dilutions of the product suspension into liquid selective medium with lactose, incubation of sowings, counting of positive flasks (tubes), transfer of the culture liquid to the surface of agarised selective-diagnostic medium for further confirmation by biochemical and cultural growth characteristics of the isolated colonies belonging to E. coli [6].

GOST 32031-2012 Methods for detection of Listeria monocytogenes

Transfer of colonies with characteristic growth for bacteria of the genus Listeria and species Listeria monocytogenes to dense nutrient media and cultivation at (37 ± 1) °C for (24 ± 3) h and their identification by appropriate morphological, cultural and biochemical features [7].

Microbiological studies of raw meat were carried out in the accredited laboratory of «Farmatsiya-Innovatsiya Markazi LLC». The results of this analysis serve as a preliminary check of raw materials before their use in culinary processes (see the appendix). The test results confirm the absence of pathogenic microorganisms in the raw beef meat under study, which confirms its compliance with microbiological safety standards established in the territory of the Republic of Uzbekistan [11]. This decisive step in quality assurance sets the fundamental basis for subsequent culinary operations, highlighting the importance of careful evaluation of raw materials to ensure the microbiological safety of the culinary production chain.

QUALITY CONTROL

Texture analysis of cooked meat samples will based on shear test and texture profile analysis (TPA) using TA.TXplus Texture Analyzer (Stable Micro Systems Ltd., Godalming, UK) equipped with a 50 kg load cell.

The shear test will be performed with a Warner-Bratzler shear blade with a v-shaped notch. The crosshead speed during the test will be 250 mm/min. The TPA test will be a two-cycle compression using the P/100 compression platen of 50 mm diameter, with sample deformation to 50% of its original height. The crosshead speed will be 50 mm/min [8,9].

For each treatment, 20 specimens cut parallel to the muscle fibers (10 × 10 × 25 mm for the shear test and 16 mm diameter, 20 mm height cores for the TPA) will be analyzed.

Our study aimed to examine the effects of different sous-vide cooking methods on tenderness and safety metrics of beef meat. Attention was deliberately diverted from the quantitative parameters of the final product, namely the protein content, fat composition and other macro- and microelements.

The Hazard Analysis Critical Control Points (HACCP) system ensures the safety and quality of sous-vide-cooked beef in a central kitchen delivered to hospitals [10]. HACCP identifies and controls potential hazards, emphasizing critical control points (CCPs) in the sous-vide process. It establishes temperature limits, monitors and records cooking parameters, and implements corrective actions for deviations. Vacuum-sealing integrity is scrutinized to prevent contamination. Documentation includes temperature records, vacuum-sealing logs, and regular audits for verification. The system also facilitates microbiological testing to validate the effectiveness of the sous-vide process in eliminating harmful microorganisms. HACCP provides a proactive and systematic approach, ensuring the continuous improvement of food safety protocols and the delivery of safe, high-quality sous-vide-cooked beef to hospital settings.

CONCLUSION

In conclusion, the use of sous vide technology in the preparation of beef for central kitchens serving hospitals in Uzbekistan holds great promise for revolutionizing the quality, safety and efficiency of food service. The short-term nature of hospital stays requires a focus on delivering nutritious and personalized meals, and sous vide cooking offers a new solution to meet these needs.

Sous vide cooking, although originated in the late 18th century, has recently gained recognition for its unique benefits. It not only improves the taste and texture of meat, but also significantly improves food safety by allowing precise temperature control during the cooking process. In our study, we selected beef tenderloin as the ideal meat cut due to its health suitability, cost-effectiveness, and availability.

The introduction of sous vide technology requires careful monitoring and testing. Microbiological testing was conducted to ensure the safety of cooked meat, as well as instrumental texture analysis to assess the tenderness and quality of the beef. Adhering to HACCP principles throughout the entire preparation process further underscores the commitment to providing safe, high-quality meals to hospital patients.

This study sheds light on the potential of sous vide cooking in hospital nutrition. This method not only meets the dietary needs of patients, but also improves the overall quality of the food. By implementing this innovative food preparation technology in central kitchens, hospitals in Uzbekistan can improve food safety, diversify menus and optimize resource use. These benefits may lead to a paradigm shift in hospital food services, ultimately improving patient satisfaction and well-being.

As we move forward, it is critical to continue to study and refine the application of sous vide technology in hospital settings, adapting it to the specific needs and limitations of each facility. Through ongoing research and implementation, sous vide cooking has the potential to become the cornerstone of safe, nutritious and delicious hospital food.

AUTHOR CONTRIBUTIONS:

Sodikov Samandar: Conceptualization, Project administration, Resources, Supervision, Writing - review & editing. Investigation, Methodology.

Khujayeva Makhliyo: Conceptualization, Resources, Writing - review & editing. Investigation, Methodology, Original draft preparation, Visualization.

Odilova Sugdiyona: Investigation, Writing - review & editing, Visualization

Kadirov Nabijon: Investigation, Writing - review & editing

All authors have read and agreed to the final version of the report.

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6. GOST 30726-2001 Food-stuffs. Methods for detection and determination of Escherichia coli
7. GOST 32031-2012 Food products. Methods for detection of Listeria monocytogenes
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APPENDICES A

Analytical passport of intermediate control of raw beef meat

Affirmed by the
Head of Analytical
Test Department
Nurmatova N.
«17» November 2023

ANALYTICAL PASSPORT OF INTERMEDIATE CONTROL

«17» November 2023

Testing Laboratory: Analytical Testing Department at LLC "Farmatsiya-Innovatsiya Markazi"
Address: Uzbekistan, Tashkent, Yunusabad district, 19/46, 100114, E-mail: Fim1234t@gmail.com
Name of products: Raw beef meat, series (batch): 01, production date: not indicated; expiry date: not indicated
Quantity of samples provided for testing: 200 g
Manufacturer: not indicated
Purpose, objectives of the test: for the purpose of intermediate control
Date of taking samples: 13.11.2023
Selection act information: Without selection act.
Test date: 13.11.2023 – 17.11.2023
Test conditions: Temperature 20-25°C, Humidity 40-70%
Information about regulatory documents: SanPiN 0366-19
Test Method Information: GOST 10444.15-94, GOST 31747-2012, GOST 30726-2001, GOST 32031-2012.
Test results: See table. Tab I

Tab I

№	Test Parameters	Specification	Result
1.	Total Plate Count, CFU/g	<10	Absent
2.	Escherichia coli group bacteria (coli-forms), in 1 g	Absent	Absent
3.	Salomonellae, in 25g	Absent	Absent
4.	L.monocytogenes, in 25g	Absent	Absent

Microbiologist: Voistinova T.A.

*These test results refer to product samples provided for testing. No part of this analytical data sheet may be reproduced in any form without the consent of the management of the testing center