(REVIEW ARTICLE)

Gastronomic optimization: Scientific approaches to enhancing restaurant performance

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Abstract

This paper examines scientific approaches to gastronomic optimization aimed at improving the efficiency of restaurants. The focus is on integrating modern technologies, including data analytics and artificial intelligence (AI), to improve the quality of service, optimize menus and manage inventory. Culinary innovations such as the Sous Vide cooking method and fusion cuisine, which enhance the gastronomic value of dishes, are also being explored. The use of data analytics allows you to better understand customer preferences and make offers more targeted, and the introduction of AI helps to increase operational efficiency and ensure uniformity in service. In addition, the importance of POS systems for sales and inventory management, as well as improving the customer experience, is emphasized. Thus, scientifically based methods and technologies play a key role in increasing the competitiveness of the restaurant business and meeting the growing demands of consumers.

Keywords: Gastronomic optimization; Optimization; Improving the efficiency of the restaurant; Optimizing the operation of restaurants

1 Introduction

Modern consumers expect not only high-quality food but also excellent service, a pleasant atmosphere, and a memorable dining experience [1]. Gastronomic technologies are actively adapting to contemporary challenges, including social, economic, and epidemiological aspects. This entails the need to consider not only society's demands for new physicochemical properties of products but also medical nutrition standards to prevent so-called diseases of civilization. The main issues are associated with the spread of chronic non-communicable diseases (NCDs).

Addressing these issues within the framework of "scientifically-based culinary arts" is justified because adequate and optimal nutrition is necessary for the normal functioning and development of the body. Recommended nutrient intake standards depend on the human life cycle and change with new medical knowledge about the etiopathogenesis of NCDs. As early as 1893, dietitian Ella Kellogg emphasized in her publication "Science in the Kitchen" that culinary art should follow scientific progress and not be limited to practical principles [2].

This paper will examine scientific approaches aimed at improving restaurant efficiency and gastronomic optimization.

2 Factors Affecting the Efficiency of the Restaurant Business

When discussing factors affecting the efficiency of the restaurant business, it is important to consider a multitude of interconnected elements, with food quality being a decisive aspect in determining a restaurant's fate. The location of

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the establishment also plays a significant role, as a prime location with high foot traffic and an atmosphere that aligns with the restaurant's theme or cuisine can attract a steady stream of visitors [3].

For full-service restaurants, service quality becomes particularly important as they typically offer more expensive and time-intensive services. Service quality is influenced by many factors, including customers' positive interactions with every staff member they encounter. For example, some customers value social interactions with waitstaff, while others prioritize the speed of table clearing and the promptness of the servers. The significance of these factors varies depending on the type of restaurant and individual customer preferences [4].

The implementation of scientific and technological advancements, technical upgrades, and enterprise cooperation positively impacts the utilization of labor resources [5]. Modern technologies continue to transform the food industry, making the process of preparing and consuming food more convenient and accessible. An example of such innovation is the Sous Vide cooking method, which uses vacuum-sealed bags and a water bath for precise temperature control. This approach ensures consistently high-quality dishes, gaining popularity among both professional chefs and home cooks [6].

Fusion cuisine, which blends various culinary traditions, continues to gain popularity. In the context of globalization, chefs from different parts of the world create unique gastronomic masterpieces by combining ingredients and techniques from different cultures. An example of such cuisine is Korean-Mexican fusion, offering dishes that combine traditional Korean flavors with Mexican ingredients, such as Korean BBQ tacos [6].

With technological advancement, personalization is becoming a key trend in the food industry. Consumers seek to tailor their dining experiences to individual preferences, leading to the growing popularity of personalized meal plans and custom food orders. The restaurant Eatsa, which uses digital kiosks to create personalized dishes, exemplifies this approach. Thus, the implementation of technology and sustainable practices significantly influences how food is prepared and perceived by people. Despite the varying degrees of popularity of these trends, one thing is clear—the food industry is constantly adapting to the changing preferences and needs of consumers.

3 General Characteristics of the Scientific Approach in the Restaurant Industry

The scientific approach to culinary techniques began to take shape in the 18th century when Jean-Anthelme Brillat-Savarin explained the chemical processes involved in cooking [7]. Physicist Benjamin Thompson Rumford contributed to thermodynamics by developing kitchen appliances such as pressure cookers and ovens. Despite many new solutions, food technology remained a secondary field of science for a long time, associated more with art [7].

Significant changes occurred in the 1960s with the development of cold storage technology (Nack system). Modern food industry enterprises, equipped with new equipment, offer products at various stages of readiness. Meanwhile, public catering establishments, often with limited resources, must meet diverse consumer demands while ensuring high nutritional value of dishes [7].

There are various food preparation systems, each with its advantages and disadvantages. The traditional system involves production, storage, and dispatch within 60 minutes at a temperature of 66°C. The menu-order system combines production and dispatch, while the "quick preparation" system limits storage time to 15 minutes [7]. The "cook-chill" and "cook-freeze" systems provide longer storage periods at low temperatures. The a'la carte system, though complex to implement, offers the best results in terms of nutrition. From production processes to preserving and enhancing flavors, food science plays a critical role in ensuring that our food is not only tasty but also safe.

The use of new tableware can also enhance the taste of food. Designer Andreas Fabian and chef Charles Michel created the Goûte utensil, shaped like a human finger, designed for creamy products. An Oxford University study found that food tastes better when eaten with Goûte rather than a regular spoon. This is because the new utensil enriches the sensory experience of eating [7].

The color of the plate or cup also matters. Researchers from the Polytechnic University of Valencia and Oxford University discovered that strawberry mousse tastes better when served on a white plate. In another study, participants rated cocoa as more delicious when served in an orange or cream-colored cup. These findings explain why many people have a "favorite" cup for drinks [7].

To apply this knowledge in practice, certified dietitian Gisela Bouvier recommends paying attention to the visual appeal of food. Colors and textures can significantly influence appetite and food perception [7]. For example, combining

different textures and adding fresh greens can make dishes more interesting and flavorful. Additionally, using white plates allows the colors of the food to stand out, making it more appetizing [8].

With this knowledge, culinary industry professionals can innovate and create new culinary masterpieces while adhering to strict quality and safety standards. Table 1 below describes the main advantages that food science presents for restaurant operations.

Table 1 Advantages of Food Science [8]

Advantage	Description
Ensuring Food Safety and Quality	The safety of the food we consume is of utmost importance. Foodborne illnesses can spoil not just dinner but also health. Here, food science plays a crucial role. Through testing, research, and development, food scientists ensure product safety and adherence to high quality standards. They analyze ingredients, explore processing methods, and develop innovative preservation techniques to make dishes both safe and tasty.
Innovations in Culinary Arts	Food science not only ensures our safety but also drives culinary innovation. From molecular gastronomy to plant-based meat substitutes, food science constantly expands horizons and revolutionizes our culinary habits. By understanding chemical reactions and sensory aspects of food, scientists create new flavors, textures, and cooking methods that excite and satisfy our taste buds.
Ensuring Food Security	With the world population projected to reach 9.7 billion by 2050, food science becomes even more significant [8]. Food scientists play a key role in ensuring food security by developing methods to increase crop yields, efficient storage techniques, and sustainable agricultural practices. Their work helps boost food production and minimize losses, creating a sustainable future.
Improving Nutrition and Health	By studying food composition, scientists develop products enriched with essential vitamins and minerals, making it easier to meet daily nutritional needs. They also work on reducing harmful additives and creating healthier alternatives for people with specific dietary requirements[8].

4   Application of Data Analytics in the Restaurant Industry

In recent years, data analytics has brought significant changes to various industries, including the food industry. In the restaurant business, data analytics helps better understand customer preferences and improve menus. The application of data analytics provides numerous benefits to restaurants. It allows for a deeper understanding of customer preferences, creating more targeted and personalized offers. Analytics also helps predict demand, eliminate unpopular dishes, and increase customer loyalty by precisely meeting their tastes.

To enhance menus, restaurants can use various types of data analytics: descriptive, predictive, and prescriptive [9]. Descriptive analytics provides information about past customer behavior, revealing important trends. Predictive analytics uses data to forecast future customer preferences, while prescriptive analytics suggests actions based on these forecasts [9].

The first step in using data analytics to optimize the menu is collecting customer data. Methods include online surveys, personal feedback, loyalty program data, and reviews from sites like Owner.com. Restaurants can also work with third parties to obtain transaction data or other sources. Once collected, the data is analyzed to identify patterns and trends related to customer preferences and behavior.

Analyzing customer data is a key step in menu optimization. There are many tools for this process, including Excel, Tableau, and SPSS. These tools help identify patterns and trends in customer preferences regarding dishes and ingredients. Restaurants can use this data to determine popular menu items, track trending ingredients, and identify best-selling dishes, which helps create new dishes that will be popular with customers, reduce waste, and optimize operations.

Analyzing customer data allows for the identification of valuable trends. By examining data over an extended period, restaurants can determine seasonal preferences, the popularity of certain cuisines, and changes in tastes. For example,

data might show a growing interest in plant-based or gluten-free dishes. Using this information, chefs can develop new offerings that align with current trends.

The key to successfully using data analytics for menu optimization is having a clear plan. Restaurants should determine what data they need, which metrics will be measured, and what goals they want to achieve. Then, they should use analytical tools to collect and analyze the data to make informed decisions about menu improvements [9]. However, to remain competitive, it is necessary to obtain objective data and analyze it to forecast future trends in the restaurant business.

By applying data analytics to evaluate your restaurant's performance, you can eliminate biases and subjective opinions. Moreover, restaurant data can be analyzed by an independent specialist who has no vested interest in the outcome of your policies. Hiring an external analytics consultant can help your business achieve greater success [10].

5 Implementation of Artificial Intelligence in Restaurant Management

For the restaurant industry, the implementation of artificial intelligence (AI) technologies can ensure consistency in service, enhance operational efficiency, and improve customer service quality. AI is capable of:

- Analyzing historical data on sales, attendance, and local events to make accurate forecasts of future demand. This helps manage inventory efficiently, minimize food waste, and ensure the availability of popular items.
- Evaluating employee performance data to identify their strengths and weaknesses. This helps create optimal work schedules, ensuring sufficient staff during peak hours and avoiding overstaffing during slow periods. Factors such as weather and local events are considered to forecast traffic and make optimal staffing decisions.
- Analyzing customer preferences and orders to suggest menu changes that increase sales. For example, AI can determine which dishes are frequently ordered together and suggest bundled offers. It also helps identify unpopular dishes for updates or removal [11].
- Tracking parameters in real-time, such as cooking times, temperature, and ingredient quality, ensuring consistency across all branches.
- AI chatbots can handle various customer service tasks, from answering common questions to taking orders, which increases efficiency, ensures immediate customer service, and frees staff for other duties. AI also collects and analyzes customer feedback to identify areas for improvement.
- Maintaining food safety standards by monitoring critical control points and alerting management to potential issues, thereby preventing sanitation violations and maintaining a safe dining environment.
- Actively monitoring and managing the supply chain, predicting potential problems, and offering solutions to prevent shortages or oversupply [12,13].

Thus, based on the above, it is evident that the implementation of AI in restaurants contributes to increased productivity, reduced operational costs, and higher customer satisfaction levels. Companies that integrate these innovative technologies can achieve significant growth and remain competitive in a saturated market. Using AI's capabilities to optimize operations, enhance customer service, and make data-driven decisions allows restaurants to realize the vast potential offered by AI applications and pave the way for a successful future. Next, we will discuss the importance of POS systems in the restaurant business.

6 Importance of POS Systems

Table 2 Functions of POS System Tools [14]

POS System Tool Name	Function Description
Sales Tracking and Analytics	The software collects and analyzes sales data, aiding in making informed management decisions.
Inventory Management	Systems monitor inventory levels in real-time, helping to avoid product shortages and reduce waste.
Loyalty Programs	Integrating loyalty programs helps retain customers and encourages repeat visits.

Online Orders and Delivery	The ability to accept online orders and organize delivery helps expand the customer base and increase revenue [14].

POS systems allow restaurant owners to manage their establishments effectively. The most in-demand features include the ability to open tabs, process, and complete transactions. However, the capabilities of POS systems do not end there. In addition to the basic functions, POS systems offer many additional features that improve restaurant management and enhance customer service quality. The functions of these tools are shown in Table 2.

Figure 1 below shows the statistics on the use of POS system tools in the restaurant industry.
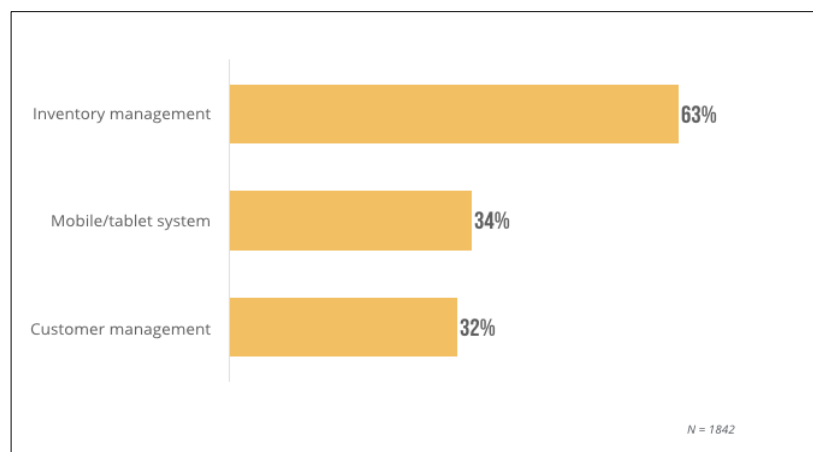

Figure 1 Tools Used in the Restaurant Industry [14]

The tools will be discussed in more detail in Table 3 below.

Table 3 Description of Tools in the Restaurant Industry

Tool Name	Description
Inventory Management Tools	These tools allow restaurants to control both perishable and long-term products, ensuring necessary stock levels. Restaurants can use them to track various product categories, including meat and dairy, which are regularly ordered.
Mobile POS Systems	They enable waitstaff to use cash register software anywhere in the restaurant, improving customer service by reducing order-taking errors and speeding up the payment process. Additionally, these systems encourage upselling by waitstaff, increasing business revenue and staff tips.
Customer Management Tools	These tools support loyalty and bonus programs by recording valuable customer information and tracking their purchases. Rewards are usually given for reaching certain purchase frequency or volume [14].

7 Conclusion

Scientific approaches to gastronomic optimization play a critical role in enhancing the efficiency of restaurant operations. The integration of advanced technologies such as data analytics and artificial intelligence significantly improves service quality, optimizes menu offerings, and inventory management. These technologies provide a deep understanding of customer preferences and help create more targeted and personalized offerings. Additionally, the implementation of innovative culinary techniques, such as Sous Vide and fusion cuisine, enhances the gastronomic value of dishes. The use of POS systems expands the capabilities of sales and inventory management, improving the overall customer experience. In summary, a comprehensive approach that combines science and innovation is a key factor for the success and sustainable development of the restaurant business, meeting the changing needs and expectations of consumers.

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