



Quantum and Tempus theories of functional food science in practice

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ABSTRACT

Functional food science has witnessed remarkable advancements in recent years, driven by our evolving understanding of quantum mechanics and the concept of time. The interplay between these two theories, namely the Quantum theory and the Tempus theory, has opened new avenues for research and innovation in functional food. Functional food science integrates these theories to better understand the complex relationship between food, chronic disease, and health. Quantum theory explores the molecular-level interplay between energy, matter, and bioactive compounds in functional foods, optimizing their development and utilization for chronic disease and health. The Tempus theory emphasizes timed consumption, aligning functional foods with circadian rhythms and metabolic processes for enhanced nutrient absorption, utilization, and metabolic responses. By synchronizing food intake with the body's natural rhythms, the Tempus theory enhances the efficacy of functional foods in promoting health and preventing disease. Integrating the quantum and tempus theories in functional food science provides a comprehensive approach to understanding and utilizing the potential of functional foods for personalized nutritional interventions and improving overall well-being.

Keywords: functional food science, Quantum theory, Tempus theory, bioactive compounds, cellular interactions, timing, health promotion, personalized nutrition.

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INTRODUCTION

The incidence and prevalence of chronic diseases have been on the rise worldwide. Non-communicable diseases, including cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes, account for the majority of global deaths [1,2]. Functional foods play a significant role in reducing the risk of disease by providing additional health benefits beyond their basic nutritional value. These foods are enriched with bioactive compounds that can modulate physiological functions and improve overall health [3]. The timing and dosage of functional foods have emerged as important areas of research, recognizing the potential impact on health outcomes. Optimal timing, in line with the principles of the Tempus theory, takes into account circadian rhythms and metabolic processes [4]. The dosage of functional foods, as addressed by the quantum theory, needs to be carefully determined to achieve the desired health effects. The quantum theory emphasizes the interplay between energy and matter at the molecular level [5]. Factors such as bioavailability, individual variations, and potential interactions should be considered when determining the dosage of functional foods to maximize their efficacy in promoting health and preventing disease [6]. Ongoing research in these areas aims to provide evidence-based recommendations on the optimal timing and dosage of functional foods, integrating the principles of the Tempus and Quantum theories.

Bioactive compounds (BC) found in functional foods demonstrate beneficial biological activities, offering extra-nutritional benefits due to their antioxidant properties and preventative capabilities. These compounds, occurring in small amounts across various food sources, can potentially reduce the risk or prevent the onset of certain diseases [7]. Functional foods are characterized by the presence of bioactive compounds, which are molecules that improve health through physiological mechanisms. The United States Food and Drug Administration (FDA) currently lacks a formal definition of functional foods. However, The Functional Food Center (FFC) has contributed to developing an improved and comprehensive definition of functional foods as well as a criterion for inducting a functional food. Functional foods are natural or processed food products that contain biologically active compounds [8]. When consumed, functional foods offer specific, effective, and non-toxic quantities that have been clinically proven and well-documented to offer significant health benefits. These benefits are exhibited through specific biomarkers, promoting optimal health, reducing the risk of chronic and viral diseases, and effectively managing their associated symptoms [8].

The table provided exhibits the steps necessary to classify a functional food and regulate it on the market by Dr. Martirosyan's team/Functional Food Center.

Table 1. Steps of inducting functional foods into the market

Step number	Description of step
1	Establishes a goal of the functional food product
2	Determines relevant bioactive compound(s)
3	Establishes the appropriate dosage of bioactive compound(s)
4	Establishes the appropriate time of consumption of bioactive compound(s)
5	Determines the specific pathway and mechanism of action
6	Establishes relevant biomarker(s)
7	Chooses an appropriate food vehicle for bioactive compound(s)

Step number	Description of step
8	Provides preclinical studies on efficacy and safety
9	Provides clinical trials for dosage, efficacy, and safety
10	Creates a special label that informs the consumers of the most effective way to consume the product
11	Publications are submitted to peer-reviewed journals, preferably in open access
12	Educates the general public
13	Sends information to credible governmental agencies, such as the FDA, for approval
14	Official establishment of the accredited functional food product,
15	Release the functional food product to the market. (Receive the basic category (level C))
16	Provides epidemiological studies. (Reapply for the approval for a new category (level B))
17	Provides after-market research. (Reapply for the approval for a new category (level A))

Step number 3 exhibits the Quantum theory of functional food science (FFS) and step number 4 exhibits the Tempus Theory of FFS

Quantum Theory of FFS: The Quantum theory serves as the fundamental theoretical framework in contemporary physics, elucidating the characteristics and dynamics of matter and energy at the atomic and subatomic scales. The Quantum theory of FFS aids in determining optimal BC quantities and identifying toxicity levels. Quantum mechanics modifies the physical properties of Functional Food Products (FFPs), allowing control over BC aspects like dosage and bioavailability [9]. Application of Quantum theory in FFS can be exhibited by identifying precise dosages at which these BC affect disease markers. Exploring the quantum nature of functional food components contributes to advancements in nanotechnology, delivery systems, and bioavailability enhancement, facilitating the development of innovative functional food products with improved efficacy and bioactivity [10]. Using the Quantum theory, it can be ensured that functional foods contain enough BC to deliver the desired health benefits advertised to the consumer.

Quantum Theory and Toxicity: To mitigate the risk of toxicity to the consumer, it is crucial to establish a suitable dosage of bioactive compounds. This can be achieved by determining the upper tolerable limit (UTL), which represents the maximum amount of a nutrient that can be safely consumed in a given time period. The UTI is derived based on the no observed adverse effect level (NOAEL). Utilizing the quantum theory of functional food science, researchers can administer varying doses of bioactive compounds to animal subjects and monitor for any signs of toxicity.

Figure 1 shows the potential for squalene to influence SOD levels. However, from the results, a higher dosage of squalene is necessary to ascertain the appropriate timing and quantity required to influence SOD levels. The conduction of further experiments is advised to align with the principles of the Quantum theory. Experiments using squalene should continue in order to identify the optimal dosage that can effectively manage symptoms of disease. However, administering treatment for a duration exceeding 84 days may not be practically feasible.

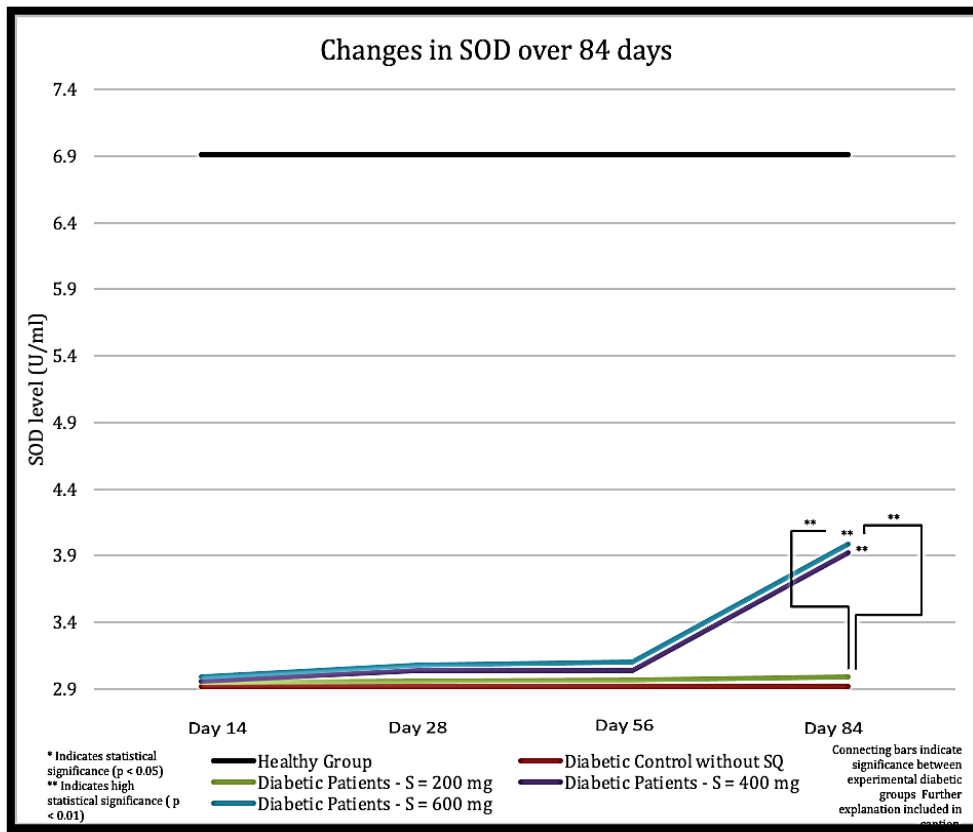


Figure 1. Variation in superoxide dismutase (SOD) levels among all five groups consuming different squalene dosages throughout the 84-day study duration [11].

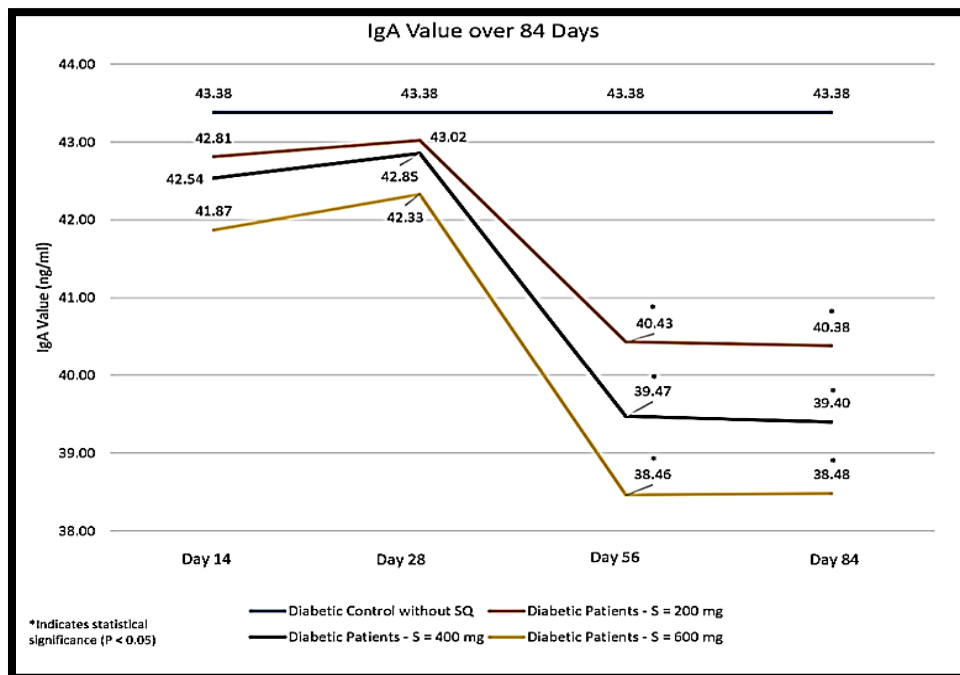


Figure 2. Illustrates the data measurements collected for IgA levels in the diabetic groups throughout the 84-day study duration.

Figure 2 exhibits that among the three dosage levels examined, it was observed that on day 56, the group administered 600mg of squalene exhibited the most substantial reduction in IgA levels. These results support

the Quantum theory and the Tempus theory as the dosage and time of the squalene administered was significant to the reduction of IgA levels.

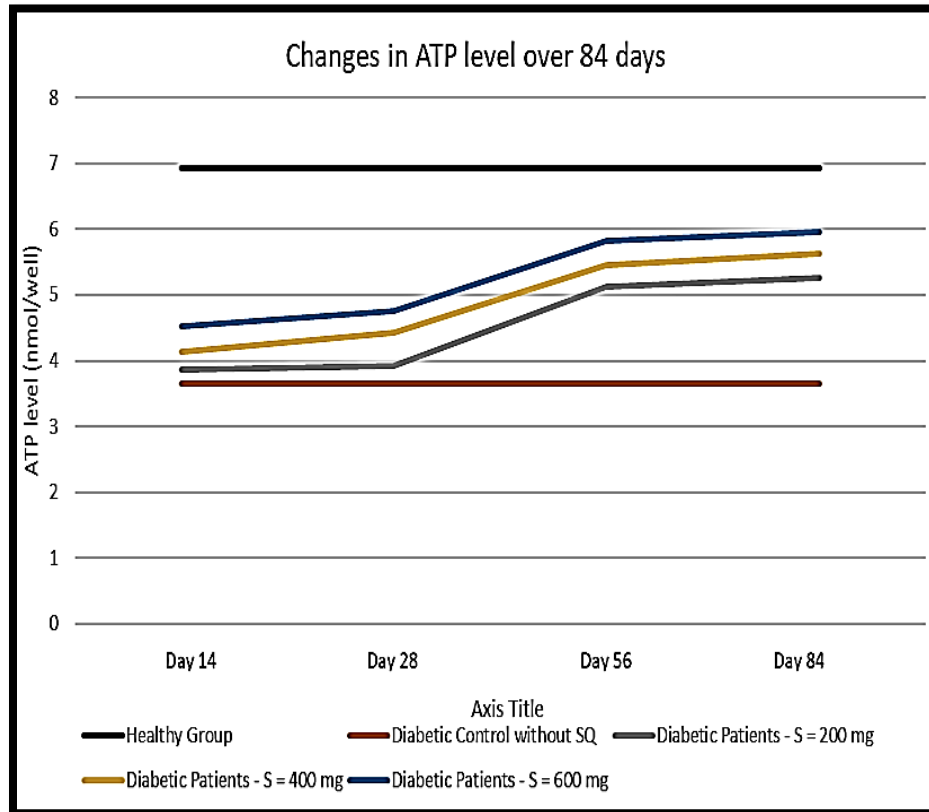


Figure 3. Illustrates the alterations in ATP levels that were monitored across all five experimental groups over the 84-day study duration.

Figure 3 exhibits that over time there was a progressive rise in ATP levels associated with the consumption of squalene, with the most notable increase occurring between day 28 and day 56. The rise in ATP levels, at different time periods and dosages consumed, suggests that squalene, a bioactive compound found in certain functional foods, may enhance cellular energy production. Squalene’s influence on ATP levels may contribute to optimizing cellular energy dynamics and aligning with the principles of quantum and tempus theories in the context of food and nutrition sciences [12].

Tempus Theory of FFS: The tempus theory in functional food science examines the potential impact of time on the efficacy of a bioactive compound in the development of functional food products. Time plays a role in determining the effectiveness of a bioactive compound by considering the duration it takes to achieve efficacy and the duration of its effects [11]. The Tempus theory considers the temporal aspects, such as optimal timing of consumption or sustained release mechanisms, that can enhance the bioavailability and overall effectiveness of functional foods in promoting health and preventing diseases. Consumers understanding and utilization of the Tempus theory can allow BC can be delivered optimally to exhibit its benefit.

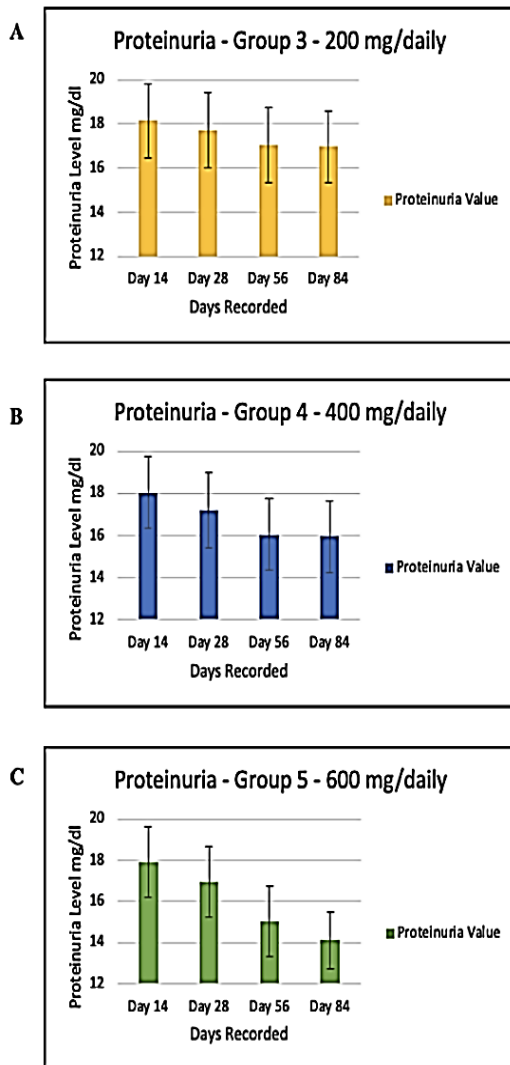


Figure 4 (A, B, C). Variation in proteinuria levels among all three groups consuming different squalene dosages (200mg, 400mg, and 600mg daily) throughout the 84-day study duration.

This study illustrates a dose and time-dependent relationship between supplementation of squalene and proteinuria levels. It indicates that higher doses of squalene yield more significant effects in a shorter duration. For instance, consuming 600mg/day of squalene reduced proteinuria to below 17mg/dl in 28 days, while 400mg/day of squalene achieved similar results in 56 days [11]. These findings highlight the significance of both the Quantum theory and the Tempus theory in FFS. These findings also provide implications as to how Quantum and Tempus theories can determine personalized treatments of BC. Variation in lipid profiles exhibited in Figure 5 highlights the Tempus theory and the relationship between the effect of squalene and its duration of consumption. Consuming a larger amount of squalene resulted in a faster improvement in HDL levels within a duration of 28 to 56 days (figure 5).

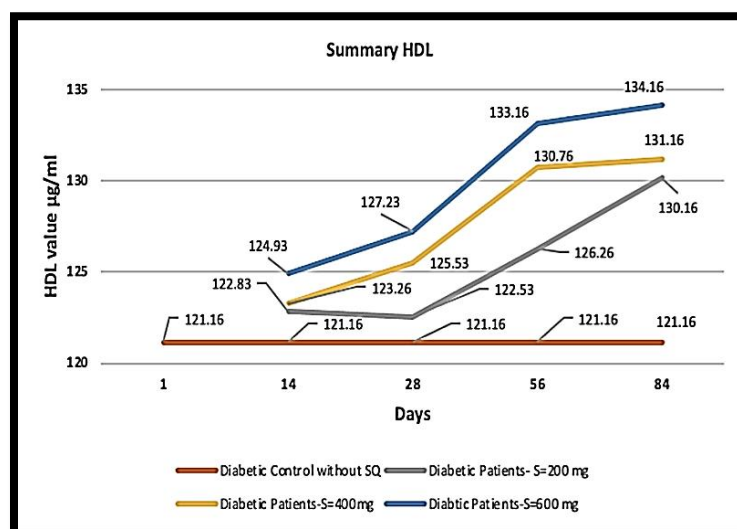


Figure 5. The variation in high-density lipoprotein (HDL) levels in diabetic patients consuming different doses of squalene throughout the 84-day study duration.

CONCLUSION

Bioactive compounds in functional foods offer valuable properties beyond basic nutrition, such as antioxidative effects and the prevention of diseases. These compounds, present in small quantities across various foods, have the potential to lower disease risk. Functional foods, characterized by bioactive compounds, improve health through physiological mechanisms [8].

Although the FDA lacks a formal definition, the Functional Food Center has contributed to an enhanced definition of functional foods. These foods contain biologically active compounds and provide specific and clinically validated health benefits. These benefits are evidenced by specific biomarkers, promoting overall well-being, reducing the risk of chronic and viral diseases, and effectively managing symptoms [9].

Determining the suitable dosage and timing for consuming bioactive compounds is a crucial stage in developing functional food products. Through clinical research and the application of quantum science in FFS, we can ascertain the dosage that yields the most favorable effects. Future investigations should incorporate the quantum and tempus theories of FFS to enhance our comprehension of the optimal quantity of bioactive compounds and establish the appropriate duration of consumption tailored to specific parameters and individual patients [10,11]. Continued research in Quantum theory and Tempus theory and functional food science is essential for advancing our understanding of the complex relationship between food and health, and for harnessing the potential of functional foods to improve well-being and prevent chronic diseases.

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Further research on the Quantum and Tempus theories of functional food science holds immense potential for transferring knowledge and insights to the field of food and nutrition science, as well as pharmacology. Understanding the quantum nature of bioactive compounds in functional foods can provide a deeper understanding of their mechanisms of action, enabling the development of more targeted interventions and therapeutics. By exploring the quantum effects of these compounds, researchers can optimize their use in drug development, potentially leading to novel pharmaceutical agents with enhanced efficacy and reduced side effects. Additionally, considering the timing aspect through the tempus theory can guide the development of personalized nutrition strategies that can complement pharmacological interventions.

Abbreviations: BC: bioactive compound; FDA: food and drug administration; FFC: functional food center; FFS: functional food science; FFP: functional food product; UTL: upper tolerable limit; NOAEL: no observed adverse effect level; SOD: superoxide dismutase

Conflicts of Interest: There are no conflicts of interest associated with this study.

Authors' Contribution: The original idea (The concept of Quantum and tempus theories of functional food science in practice) was conceived by DM and was discussed with SS. SS collected data and wrote the manuscript. DM advised and participated in writing, and editing the manuscript.

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