iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** IV **Month of publication:** April 2025

DOI: https://doi.org/10.22214/ijraset.2025.69771

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

The Role of Gluten Proteins in Food Production: Quality ofYeast-Leavened Sugar

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Abstract: The present paper studies the impact of gluten polymerization on the quality of yeast leavened sugar and fat rich developed dough model systems. This was done using an approach based on the use of the redox agent's l-cysteine and potassium iodate, and N-ethylmaleimide to selectively alter the properties of the wheat gluten proteins in such model systems. Despite the high levels of sugar and fat in the system, redox agents affected dough expansion during fermentation and protein polymerization during baking. The data suggest that both gluten development during mixing and subsequent polymerization during baking are related to dough expansion and shrinkage and determine product dimensions. The extent of gluten polymerization determines spread rate during baking and product dimensions. Increased protein polymerization during baking yields firmer products.
Keywords: Gluten, food processing, digestibility, celiac disease, dietary restriction,

I. INTRODUCTION

Rheology measures the deformation of a material in response to the application of mechanical force the force is usually defined in terms of stress, the amount of force applied per unit area, with strain being the resulting deformation. Both of these terms need to be considered with respect to the instantaneous state of the material during deformation. If a sample is stretched by uniaxial extension then its cross sectional area will reduce; thus the stress applied will be time dependent Adding several different compound flours when preparing gluten-free bread Increasing nutritional value by adding an ingredient rich in dietary fiber, Increasing the amount of dietary fiber, as well as increasing vitamin content, and reducing the price of gluten-free bread by using Central Asia raw materials instead of imported ones.As a result of this research, a beneficial natural product, gluten-free clean bread, and baked goods have been developed and tested in surveys in terms of taste and consistency to address and prevent gastrointestinal and allergic diseases, including celiac disease, and promote overall human health. Additionally, nutritional value has been enhanced, and clean food consumption with high nutritional quality is encouraged. These innovative works can contribute to the improvement of human health through the provision of gluten-free, clean, and nutritious bread and flour products.

II. LITERATURE REVIEW

A previous paper demonstrated that both the gluten level and quality determine gluten network development during mixing of wheat flour dough systems that contain high levels of sugars and fat. These parameters largely affect dough spread during fermentation and baking and, thus, product dimensions However it is unclear whether in such systems, besides the impact of gluten development during mixing, subsequent polymerization during baking also influences dough spread and, hence, the quality of the baked products.In cookie dough systems lacking a developed gluten network and containing high levels of sugar and fat, protein polymerization at least partly impacts collapse during baking, and thus the dimensions of the baked products. In such systems, during baking and subsequent the product's height but not its diameter decreases Parent Talhaoui to an extent depending on the degree of protein polymerization The ability of batter based cake systems to resist collapse during cooling determined by the structural strength of the crumb, which in turn is impacted by the degrees of both starch gelatinization and protein aggregation. From the above, it is clear that protein polymerization during baking profoundly impacts the properties of wheat based systems made from developed dough such as bread made from dough or batter which is not developed, but contains high levels of sugar and fat, such as is the case in cake and cookie systems .However, published work on gluten protein polymerization during baking of developed yeasted dough systems containing high sugar and fat levels such as used for Belgian waffle production is scanty. Therefore, his study aimed at elaborating on the importance of gluten polymerization for the quality of such model systems. Protein polymerization during baking was monitored and related to macroscopic phenomena such as dough expansion and shrinkage, as well as to the product's firmness. The authors are grateful to Ir.

Anne lien Regale and Kim Mellette for their technical assistance. We thank the Agentschap over Innovative door Wetenschap en Technologies in Vlaanderen for financial support. Bram parity and Kristofer brims acknowledge the Research Fund – Flanders (FWO – Vlaanderen, Brussels, Belgium) and the Industrial Research Fund (KU Leuven, Leuven, Belgium), respectively, for their position as postdoctoral researchers.

Health implications of the consumption of gluten-free bread Celiac Disease Management Essential for individuals with celiac disease to prevent autoimmune reactions triggered by gluten Sensitive Maprovide relief for individuals with non-celiac gluten sensitivity, although more research is needed. Nutritional Concerns Potential for nutrient deficiencies, especially in fiber, iron, and B vitamins if not fortified Weight Management Gluten-free bread can be higher in calories and less satiating, potentially impacting weight management. Gastrointestinal Health May help improve gastrointestinal symptoms in those with gluten-related digestive issues Diabetes Management Gluten-free bread's glycemic index can vary, impacting blood sugar control for those with diabetes Bone Health Possible reduction in calcium intake if not fortified, affecting bone health, especially in children.

In recent years, the awareness and willingness of consumers to consume healthy food has grown significantly. In order to meet these needs, scientists are looking for innovative methods of food production, which is a source of easily digestible protein with a balanced amino acid composition. Yeast protein biomass (single cell protein, SCP) is a bioavailable product which is obtained when primarily using as a culture medium inexpensive various waste substrates including agricultural and industrial wastes. With the growing population, yeast protein seems to be an attractive alternative to traditional protein sources such as plants and meat. Moreover, yeast protein biomass also contains trace minerals and vitamins including B-group. Thus, using yeast in the production of protein provides both valuable nutrients and enhances purification of wastes. In conclusion, nutritional yeast protein biomass may be the best option for human and animal nutrition with a low environmental footprint. The rapidly evolving SCP production technology and discoveries from the world of biotechnology can make a huge difference in the future for the key improvement of hunger problems and the possibility of improving world food security. On the market of growing demand for cheap and environmentally clean SCP protein with practically unlimited scale of production, it may soon become one of the ingredients of our food. The review article presents the possibilities of protein production by yeast groups with the use of various substrates as well as the safety of yeast protein used as food.

With the global human population explosion, the demand for food increases rapidly, especially for protein products. The world's population is estimated to increase by 2 billion people in the next 30 years, from 7.7 billion currently to reach 9.7 billion by 2050 and could peak at nearly 11 billion around 2100, of which about two-thirds are supposed to live within urban areas. Population growth in combination with rapidly increasing demand for meat nutrition are creating a protein deficit between the meat available and the expected demand in 2050 and following years. Global demand for meat as a protein source is steadily increasing. Over the past 50 years, meat production was increased more than three times. Each year, 80 billion animals are slaughtered for meat. Throughout the world, the average person consumes nearly 43 kg of meat a year. However, richer people eat much more meat, about 80 kg in Europe and even over 100 kg in the US and Australia. Additionally, numerous studies showed that there is the association between consumption of red meat or processed meat and cancer risk. Large consumption of red meat significantly increases the risk of colon and rectum cancer, and some studies also demonstrated that red meat consumption is associated with some other cancers, such as pancreatic and prostate cancer. Moreover, high levels of animal protein intake may also significantly increase the risk of premature mortality from cardiovascular diseases, and type 2 diabetes.

In about half of African countries, people consume as low as 10 kg meat per person a year. In these countries, there is protein source deficiency which is beginning to be a public health problem. However, shortage of protein sources such as meat, dairy, and plant protein would be limited not only to developing countries in Africa, Asia, and South America, but can also become a problem in more advanced countries in the future. Therefore, one of the world's most urgent challenges for the growing population is the production of easily accessible protein products in such a way that they do not have a negative influence on life. Furthermore, people from advanced countries are interested in developing healthier food, with optimal composition of amino acids and good quantity and quality fat, produced in an environmentally friendly manner. Plants are nutritionally valuable protein sources (they may represent more than 50% of the protein used in animal feed), but require many acres of arable land and lots of water. Moreover, currently, soybean meal is a main protein source for feedstock production, but it is suggested to replace plant feed with microbial biomass including post-fermentative yeast biomass in animal diets up to 100% [9]. In the case of animal protein, the time to obtain it is much longer, and it does not have a differentiated amino acid profile compared to yeast protein. Animal proteins are not available at reasonable prices to all people around the world. Therefore, the need for protein leads to scientific challenges aimed at designing new nutritional strategies and the search for alternative nutritional sources of protein.

Obtaining single cell proteins from yeast cells obtained from cultivation in waste products from various branches of the agri-food industry may be particularly important in the case of traditional agriculture. It is very important to conduct scientific research aimed at obtaining the highest efficiency of protein production and an appropriate amino acid profile in yeast cell biomass. Thus, obtaining a balanced, renewable high-protein ingredient is an interesting alternative to classic protein products. Therefore, the answer to humankind's challenge to meet the need of protein products seems to be the protein produced by various microorganisms such as bacteria, yeast, algae, and fungi. This microbial protein is also called bioprotein, protein biomass, or single cell protein (SCP), though filamentous algae and fungi may be multicellular . SCP is dead and dried biomass of microorganisms which culture on various carbon and energy sources (Figure 1). SCP agricultural, food, and industrial residues and wastes are potential substrates for microbial protein production.. Obtaining microbial protein by conversion of waste substrates to value-added feed and food as high-nutritional protein biomass and thus reduction of environmental pollution is a very valuable feature of SCP production . Particularly, yeast plays a special role in purifying the environment from waste materials, especially oleaginous yeast such as and Candida spp. that are capable of growing on many industrial wastes including alkanes, petroleum by-products, natural gas, glycerol, biofuel waste, and plant or animal-waste fats The oily waste biodegradation by this yeast has a significant importance for environmental protection Production of fuels such as petrol and biodiesel generate huge amounts of residues, by-products, and wastes which cannot be utilized in these production processes. One of the methods of getting rid of oily waste products after processing petroleum is its use as a culture medium for the production of added value compounds, such as protein, by yeast that can utilize these wastes Furthermore, both food grade or industrial wastes as well as forestry and agricultural sources are easily available and low- or even free-cost substrates as carbon and energy sources for SCP production by yeast

III. THE ROLE OF GLUTEN IN FOOD

The dynamic changes of morphology, distribution, and molecular/structural transformation of gluten during the processing of various foods affect the formation, destruction, and recombination of gluten networks, thus affecting the quality of various foods. Individuals more effectively select or prepare foods that meet their dietary needs by understanding the performance of gluten in a variety of foods and simultaneously comprehending the influence of the gluten network on the characteristics of the final products. It also provides scientific evidence and guidance for people with dietary restrictions and allergies to better meet individual dietary needs and achieve dietary safety.

Gluten occupies a significant part of the wheat raw material and forms the gluten network through the process of hydration and mixing.

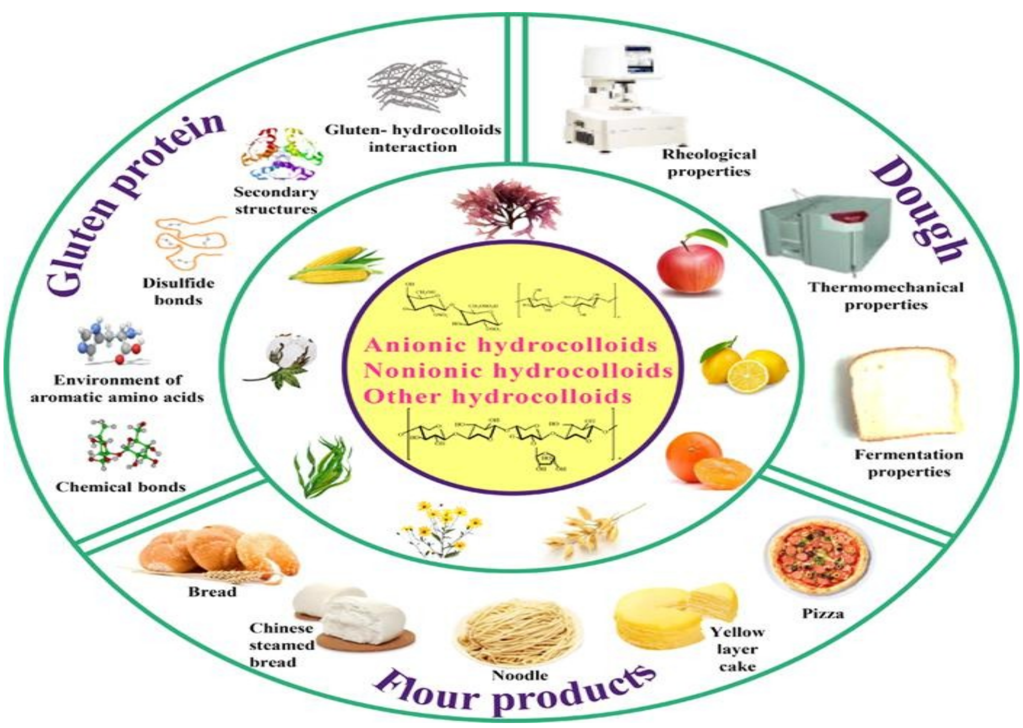

Figure 1. Gluten Protein in Food Production

Hydrocolloids are polymers with long chains, such as water-soluble polysaccharides, that can modify solution characteristics to create gels or achieve functions like thickening, emulsifying, coating, and stabilizing. Their molecular makeup features numerous hydrophilic groups, including carboxyl, hydroxyl, and amino groups, which grant hydrocolloids the ability to disperse easily, be fully or partially soluble, and expand in water. Many hydrocolloids serve as food additives because of their superior functional attributes (Fig. 1). Consequently, they are extensively utilized to enhance the quality and functional characteristics of flour products.
In the examination of hydrocolloids' impacts on gluten proteins, dough, and flour products, anionic hydrocolloids primarily consist of sodium alginate (ALG), xanthan gum (XG), carrageenan, high-methoxy pectin (HMOP), low-methoxy pectin (LMOP), and carboxymethyl cellulose (CMC), while nonionic hydrocolloids encompass arabic gum (AG), guar gum, locust bean gum, konjac glucomannan, and hydroxypropyl methyl cellulose (HPMC). Inulin, β-glucan, and arabinoxylan, noted for their high biological activity, are categorized as other hydrocolloids. The majority of hydrocolloids are incorporated into flour products as dough enhancers to help retain moisture and ultimately extend shelf life stability. Additionally, locust bean gum increased the stability duration of dough, while carrageenan heightened the resistance to extension. At the same time, HPMC augmented the product volume, and guar gum curtailed cooking losses while enhancing noodle quality. However, it has been suggested that hydrocolloids can also dilute gluten proteins, disrupt gluten network formation, and impair dough quality.
Given the intricate structure of hydrocolloids, their mechanisms of influence on gluten proteins, dough, and flour products are complex. The latest research indicates that ionic bonds, hydrogen bonds, and hydrophobic bonds are the three principal types of chemical bonds formed between hydrocolloids and gluten proteins. Several factors dictate the occurrence of these effects, including chemical structures, interactions with other components, and processing parameters. Therefore, this review discusses the effects of anionic, nonionic, and other hydrocolloids on gluten proteins, dough, and flour products to provide a theoretical foundation for applying hydrocolloids in the processing of flour products.

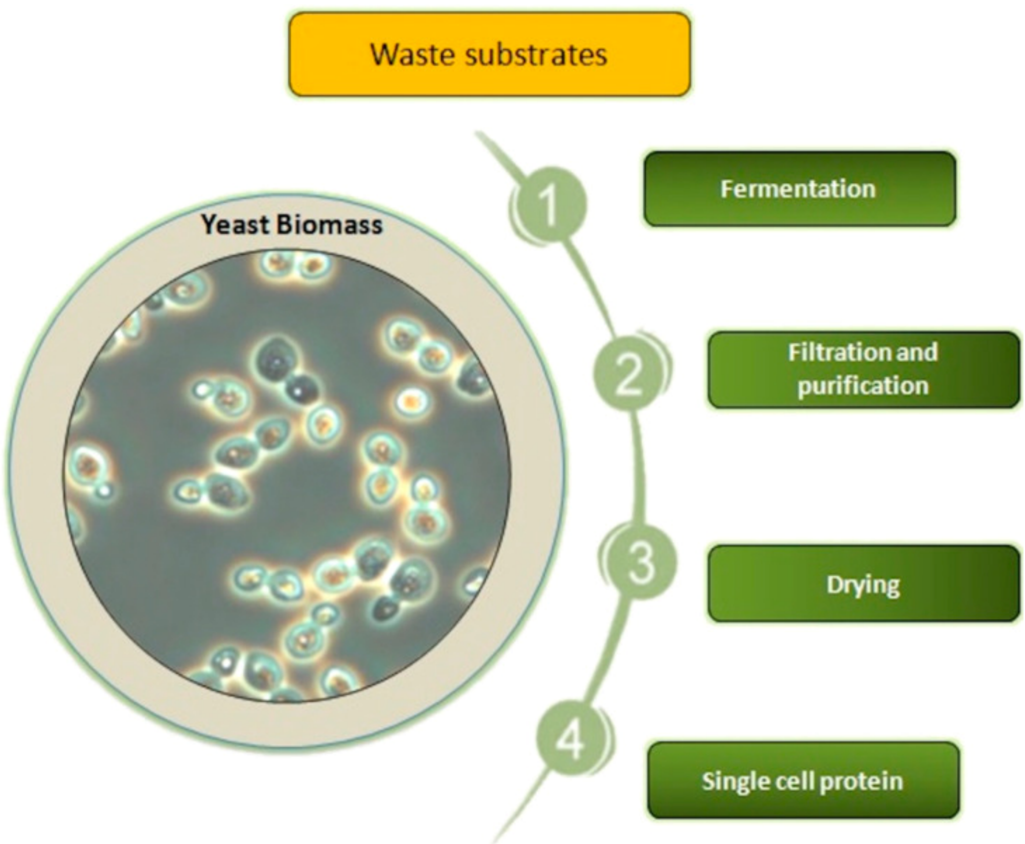

Figure2 : Yeast Protein

This unique structure confers the ability to process gluten into a wide variety of food products. Currently, a number of substantial advances have been made in the study of the gluten network in terms of its supportive and rheological properties in the dough. However, gluten networks undergo structural changes during subsequent processing that give them different roles in food products.

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For example, gluten networks swell during fermentation to retain gas, thereby affecting the fluffiness of bread. Therefore, it is still necessary to conduct in-depth studies on the role of gluten in various types of foods after processing.Meanwhile, gluten is a complex protein whose digestion in living organisms is crucial for providing nutritional advice. The digestibility of gluten is affected in complex food matrices. Researchers can improve the bioavailability of gluten by studying the digestibility of gluten in different factors. From a production perspective, it will contribute to a shift in gluten processing from the current empirical approach to more rational and specific processing principles.

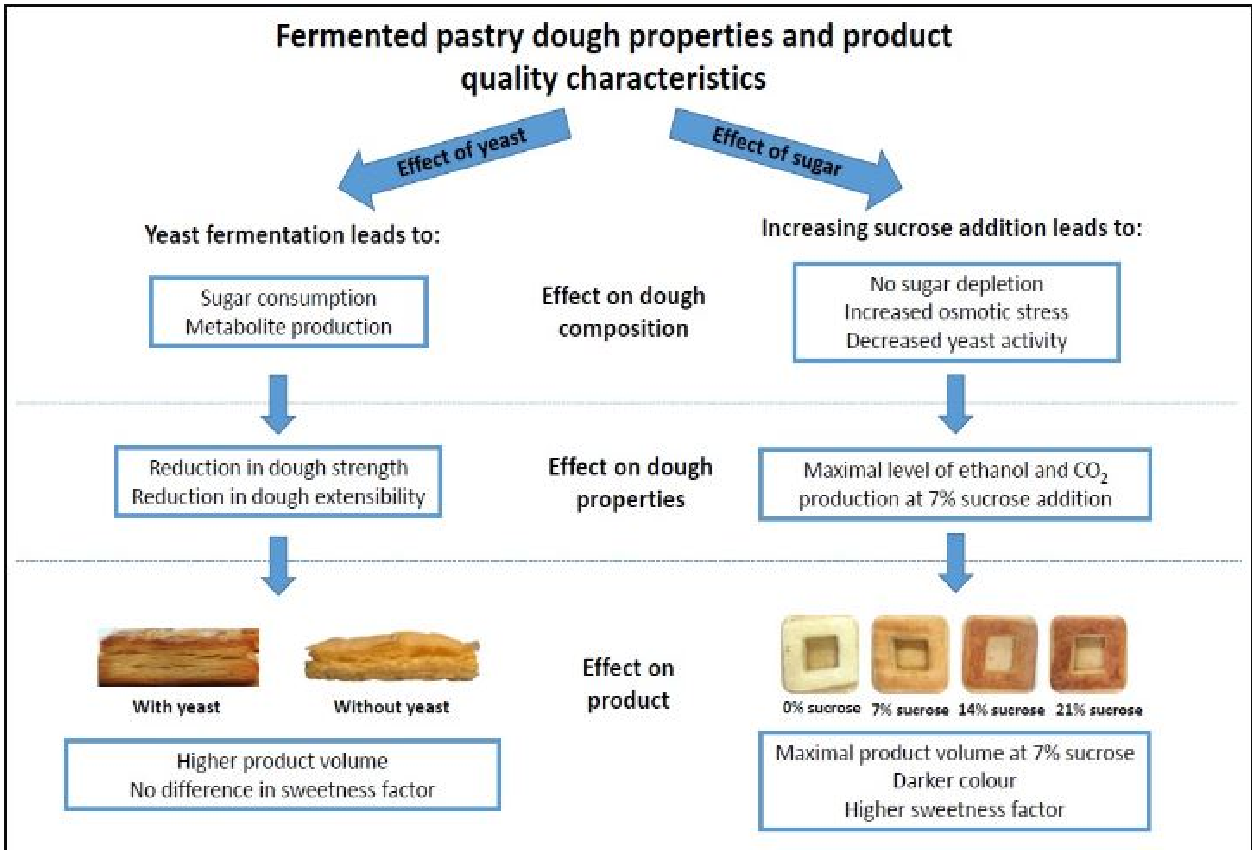

Figure 3. Fermented Dough

Protein is considered a key component of the diet in assessing the needs of the human body. Proteins are the basic structural and functional components of every cell. They are essential for the development and metabolic processes. The importance of protein as a nutrient is to supply the body with nitrogen and certain types of amino acids. Naturally, the source of proteins and amino acids are raw materials or food products. Yeast protein biomass could contain higher amounts of protein than those obtained from the traditional protein sources such as plants or animals. The protein amount in yeast biomass is usually similar or higher compared to protein of meat and soybean and is higher than milk protein. Moreover, the protein efficiency ratio standardized for casein (PER) of SCP yeast species compares favorably with the PER of the traditional sources of protein. The amino acids content in protein biomass among yeast species is comparable with a high content of lysine, the most limiting amino acid in wheat, e.g., cereals. In the yeast protein amino acids profile, the contents of isoleucine, leucine, lysine, phenylalanine, threonine and valine are higher than these required by Food and Agricultural Organization (FAO)/World Health Organization (WHO) for the human diet. The preferable protein content is above 40%. One hundred grams of yeast biomass contains a mean of 47 g of protein which corresponds exactly to almost 100% of recommended daily intake for adults (50 g). Yeast protein also contains all essential amino acids in the required quantity according to FAO recommendation, making yeast SCP a complete protein. It is worth emphasizing that protein deficiency may be caused not only when there is a state of relative or absolute deficiency of body proteins but also when one or more of the essential amino acids are missing. Therefore, yeast biomass provides a good quality protein with healthy balance of amino acids including complete exogenous ones, being adequate for human and animal consumption.

IV. CONCLUSIONS

The research aimed to develop an advanced technology for producing gluten-free bread by meticulously analyzing various gluten-free flours. By experimenting with different combinations of ingredients, the technological process was fine-tuned to achieve a successful recipe for gluten-free bread containing corn, green buckwheat, and plantain flour in a ratio of The key discovery was a unique gluten-free blend comprising cereal-based and pseudo-cereal-based flours, which remarkably enhanced the texture and taste of the gluten-free bread while maintaining a gluten content below as a result, the gluten-free bread exhibited characteristics closely resembling traditional wheat bread, boasting excellent color, aroma, softness, and full compatibility with gluten-free diets. Moreover, the study delved into the nutritional composition of gluten-free bread. While these results were promising, further investigation is essential to explore the potential effects of gluten-free fermentation properties. the research was successful, elevating the technology for gluten-free bread production through meticulous analysis of gluten-free flours. The valuable findings contribute significantly to the advancement of gluten-free bread products, offering essential insights to manufacturers and researchers. Future studies should focus on investigating the intricate interplay between different compositions of gluten-free flours or alternative ingredients, thereby optimizing the gluten-free bread recipe further. These ongoing endeavors will undoubtedly deepen our understanding and expand the scope of possibilities for creating top-tier, high-quality gluten-free bread products.

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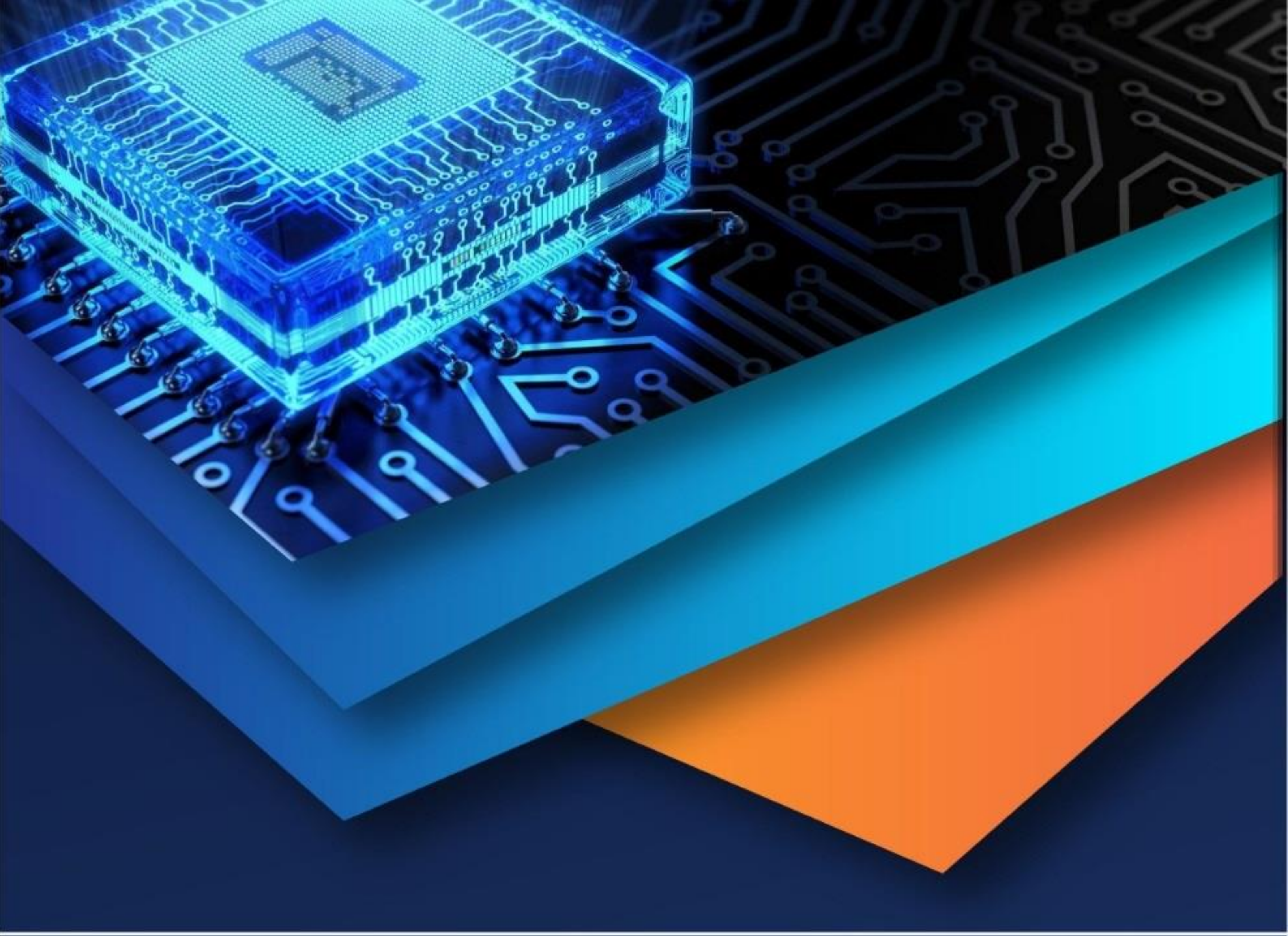

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