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Value Added Food Products from Under-Utilized Soy Beans and Millets – From Laboratory to Industry

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Abstract: ***The present study focuses on the production of value added products from nutritionally rich under-utilized ingredients like soybean and millets. The practice of fortification of yoghurt with health promoting additives is gaining popularity and is expected to fulfil more nutritional needs also. Continuous efforts are being made to develop yoghurt from certain non-conventional food sources such as soybeans to convert them to more acceptable and palatable forms thus producing low-cost nutritious foods. In the present study, soy-based fermented product – soy yoghurt was prepared and fortified. Supplementation of cereal based products with millets has become increasingly popular due to nutritional and economic advantages. Value added products from the less explored minor millets such as Finger millet, Foxtail millet and Pearl millet were prepared to investigate their health benefits and to be an alternative to cereals. The research work is being pursued to explore the inherent technological opportunities for better utilization of these resources in designing value added and sustainable foods in different sectors of food industries in India. This work aims to popularise the value of soybeans and millets by developing value added products from soybean and selected millets.***

Keywords: fermented, millets, soybean, sustainable, under-utilized, value added

I. INTRODUCTION

The demand for alternatives to cow's milk is growing due to problems with lactose intolerance and desire for more 'vegetarian' alternatives. Instead of the traditional milk, cheese and butter concepts, more functional products such as yogurt and probiotics are now being accepted as the medium for good health. Soymilk is considered as a suitable economical substitute for cow's milk and an ideal nutritional supplement for lactose-intolerant population. Interest in fermented soybean products, such as yoghurt, soy sauce and soy paste, has grown in recent years. Fermentation is considered to be an efficient way to produce bioactive peptides. Many bioactive peptides have also been identified in fermented soymilk. Fermentation improves the bioavailability of is flavones, assists in digestion of protein, provides more soluble calcium, enhances intestinal health, and supports immune system. Soy milk-based yogurts have emerged as a popular alternative to traditional dairy-based yogurt due to strong antioxidant properties which have capability of lowering cholesterol and saturated fat and thus have gained significant consideration for their nutritional health benefits and are expected to drive the growth of yogurt market in the near future [1], [2]. The fundamental constraint in processing of soybean is bitter taste development. Soymilk as a base for production of beverages remained deprived of commercial exploitation because of its low acceptability associated with unpleasant flavour and bitter taste. Fortification of soymilk improves the acceptability of the beverage as well as nutritional value of beverage [3]. But studies are still scanty in this area and therefore interest in a soy-based fermented product has been identified as one of the prime objective of the present study.

Millets are high energy, nutritious foods comparable to other cereals and some of them are even better with regard to protein and mineral content. They are particularly rich in dietary fibre, iron, calcium and B vitamins. Though millets have diversified high food value, their consumption has declined as compared to other cereals like rice, due to change in the life style. In recent years, there has been growing demand for functional bakery products because they are generally perceived as healthier than their counterparts. Hence an urgent effort is needed to increase the utilization of millets in various food items which would find ready acceptability with the tag of 'HEALTH FOODS'. Millet, being the staples for the poorer sections of population could be the choice of fortification [4]. Being comparable and even superior to many cereals in terms of mineral and micronutrient contents, the major use of minor millets as food has remained only in the area where it is cultivated and to the traditional preparations. These millets have good potential of providing nutritional security to the consumers. With the advancement of post-harvest processing and value addition

technologies, their consumption can be increased in urban area [5], [6]. The project addresses the production of value added products from the less explored minor millets and their fortification thereof for better health benefits to mankind.

II. MATERIALS AND METHODS

Soybeans, minor millets (Finger millet, Foxtail millet and Pearl millet), flax seeds and chia seeds were purchased from the local supermarket, Margao, Goa, India. Date seed powder and wheat grass powder were made in the laboratory.

A. Production of value added products from Soy beans

Soy beans of good quality were carefully selected and soaked for overnight in sterilized water. Hulls were removed by manual rubbing. The soaked soybeans were blended in a blender for and the resultant slurry was filtered. The milk thus extracted was boiled and cooled down for yogurt preparation. Batches of yogurt were prepared in sterilized glass bottles containing 100 ml of soy milk which was inoculated with starter cultures of routine household yoghurt (0.5 %) and incubated at 37°C for approx. 6-8 h and stored at 4 °C. Value added soy yoghurt were prepared by incorporating fruit pulp from banana / fig / desiccated coconut / papaya / strawberry / pomegranate and chikoo puree and refrigerated.

B. Value Added Products from Minor Millets

The value added products, cookies, were prepared with minor millets such as finger millets/ foxtail millet/ pearl millet as one of the basic ingredients and date seed powder, wheat grass powder, flax seed powder and chia seed powder as fortifying ingredient (5% w/w). The multi grain cookies consisting of all three millets in equal proportion and fortifying agents (5% w/w) were also prepared. The steps adopted to make cookies are those customarily used for bakery food products, especially biscuit-type products and hence not detailed in this report.

C. Sensory Evaluation of the Products

The quality properties of the products that were evaluated were colour, texture, firmness, taste, sweetness, sourness, flavour and overall acceptance. The overall acceptability of each product was done on a Nine Point Hedonic Scale which is the most widely used scale for measuring food acceptability. The product that ranked the highest was further analysed for its proximate nutritional value and its comparison with the commercially available biscuit was studied.

III. RESULTS AND DISCUSSION

In the present study, soy yogurt were prepared using a simple method and fortified which highly improved the sensory evaluation scores of the bio-yoghurt. Among the various products prepared, the one fortified with desiccated coconut masked the objectionable taste of soy bean has been graded for its acceptance through sensory evaluation (Fig 1).

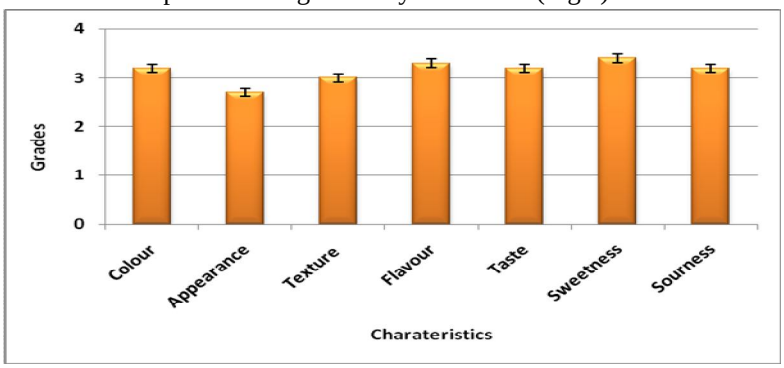

Fig 1. Sensory Evaluation of Soy Yoghurt Fortified with Desiccated Coconut
*Sample size of each parameter is 30. ± indicates mean ± SE

Similar preparation of soy yoghurt fortified with fruit pulp was done by [7], [8] using mango puree and banana puree respectively. Dairy products have been a part of human diet in many parts of the world. With the advancement of technology, it is now common to find different types of flavours such as banana, strawberry, lemon, apple, and so forth that have increased its popularity. Owing to expanding market size of dairy companies, there has been merging of dairy products and fruit beverage markets with the introduction of hybrid dairy products which are able to offer health and flavour. Continuous efforts are being made to develop

yoghurt containing certain non-conventional food sources such as soy beans and millet and convert them to more acceptable and palatable forms thus producing low-cost, nutritious fermented foods [9], [10].

Cookies with finger millets or foxtail millet or pearl millet as one of the basic ingredients and date seed powder/wheat grass powder/flax seed powder/ chia seed powder were prepared. Multigrain cookies with equal proportion of finger millets, foxtail millet and pearl millet and date seed powder/wheat grass powder/flax seed powder/ chia seed powder as minor ingredient were also prepared and the sensory scores were evaluated (Fig 2a-j).

a b c d

e f g h

i j

Fig 2 a-j: Value Added Millet Based Baked Products

Fig 2 a: BISCUITS WITH WHEAT FLOUR AND DATE SEED POWDER
Fig 2 b: BISCUITS WITH JOWAR FLOUR AND DATE SEED POWDER
Fig 2 c: MULTIGRAIN BISCUIT
Fig 2 d: BISCUITS WITH WHEAT FLOUR AND FLAX SEED POWDER
Fig 2 e: BISCUITS WITH WHEAT FLOUR AND WHEATGRASS POWDER
Fig 2 f: WHEAT FLOUR WITH SPROUTED WHEAT AND PANEER
Fig 2 g: BISCUITS WITH FINGER MILLET FLOUR AND FLAX SEED POWDER
Fig 2 h: BISCUITS WITH WHEAT FLOUR AND WHEATGRASS POWDER
Fig 2 i: BISCUITS WITH SOY FLOUR AND FLAX SEED POWDER
Fig 2 j: BISCUITS WITH JOWAR FLOUR AND WHEATGRASS POWDER

The results of this study suggest that date seeds / flax seed / wheat grass could be potential promising fortifying agents for functional food in order to prevent and treat illnesses and improve overall health, according to their nutritional and antioxidant characteristics.

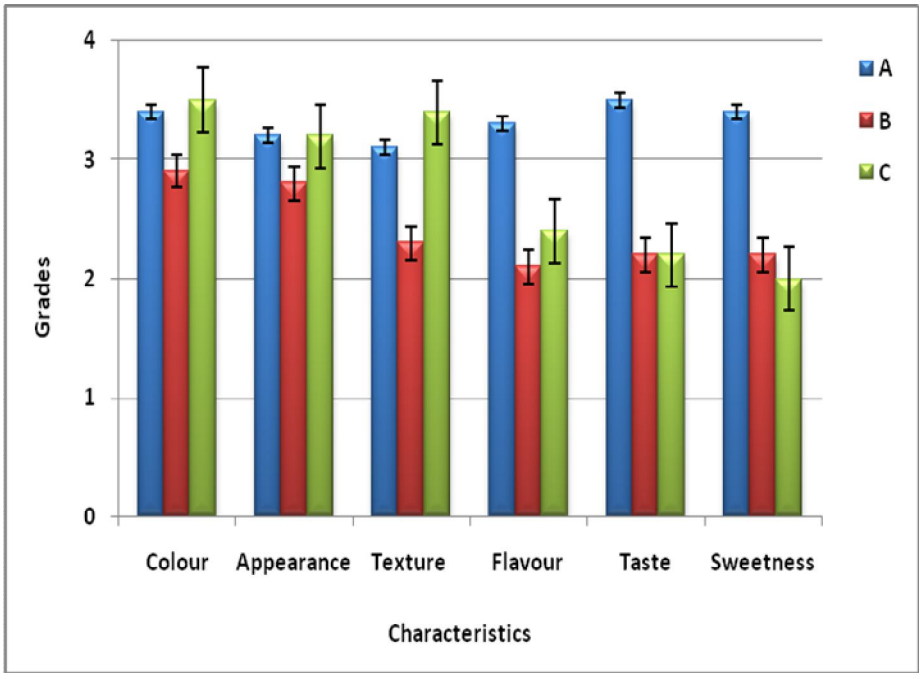

Fig 3. Sensory Evaluation of Soy Based Baked Products Fortified with :
A- With Date Seed Powder, B- With Wheat Grass Powder, C- With Flax Seed Powder

*Sample size of each parameter is 30. ± indicates mean ± SE

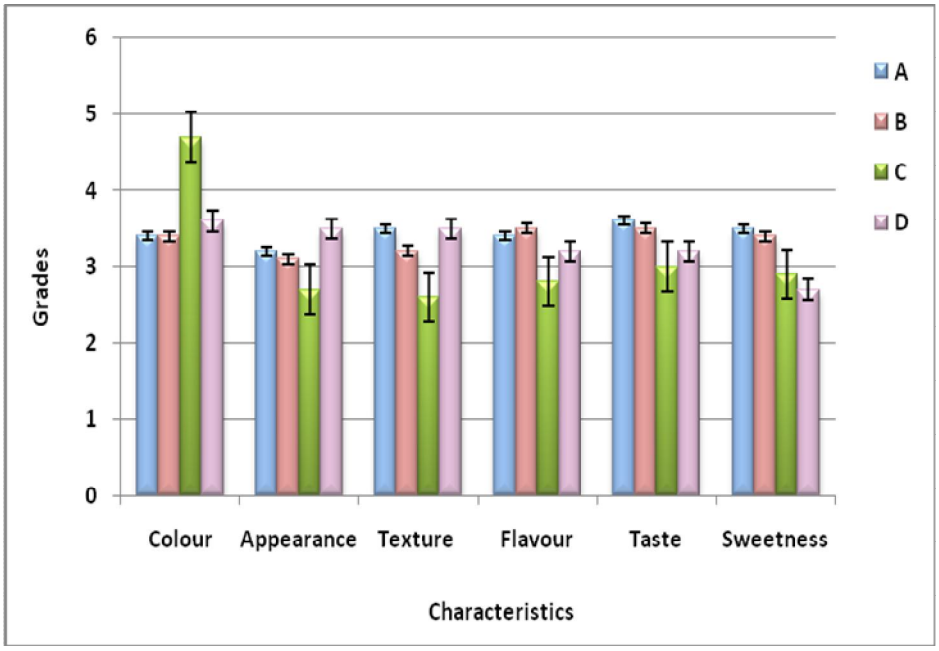

Fig 4. Sensory Evaluation of Millet Based Baked Product fortified with:

A- Jowar flour + Wheat flour + date seed powder
B- Jowar flour + date seed powder + wheat flour + foxtail powder + flax seeds + wheat grass powder + chia seed powder + soy flour
C- Jowar flour + wheat grass powder
D- Finger Millet Flour + Flax seed powder
*Sample size of each parameter is 30. ± indicates mean ± SE

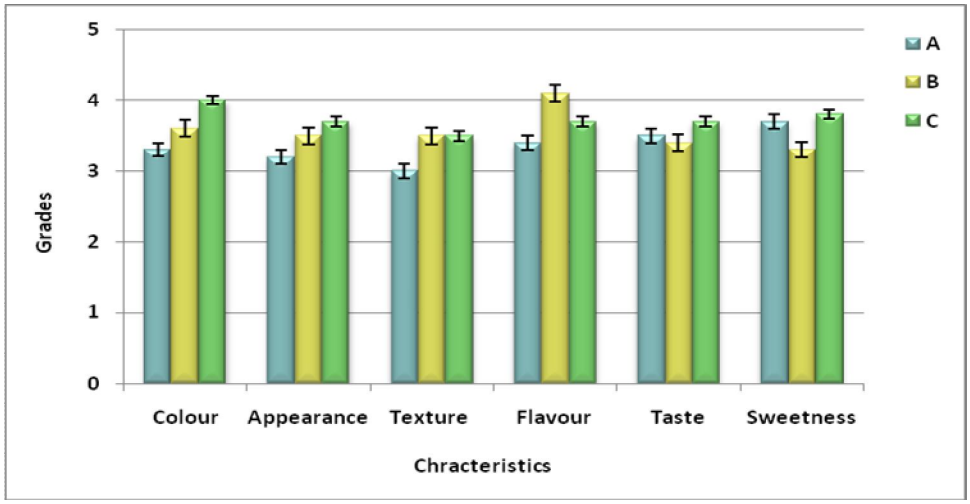

Fig 5. Sensory Evaluation of Wheat Based Baked Products fortified with:

A- Wheat flour + Date seed powder, B- Wheat flour + wheat grass powder, C- Sprouted wheat + crumbled paneer + Onion-Chilli Paste

*Sample size of each parameter is 30. ± indicates mean ± SE

The multi grain biscuit ranked highest among the other biscuits, further analysis of the same for its proximate nutritional value and its comparison with the commercially available biscuit revealed that the energy, protein, fats and fibre content were higher. As the dietary fibre helps maintain bowel health and also controls blood sugar levels, the fibre content of the multigrain biscuit could be increased by increasing the quantity of all the minor ingredients [11]. The biscuits made using sprouted wheat as the main component ranked second. Since germinated wheat comprises 2 or 3 times more vitamin B than the common kind; the seeds are useful for treating gastrointestinal, skin, respiratory and cardiovascular ailments. The nutritional value can further be enhanced by the addition of date seed powder / wheat grass powder.

The millets remain virtually un-researched and their potential untapped. Millet processing research in the area of value addition has extended its scope to promote millets to become a mainstream food ingredient in health foods, fermented food and bakery products. Nutritional deficiencies are of major concern to policymakers in developing countries [12]. Growing populations, hunger, poverty, and lack of nutrition education are major hindrances in eradicating these deficiencies. Multiple strategies are available to overcome this situation, including food diversification, supplementation, fortification, and production of crops with enhanced levels of these micronutrients. Among these strategies, fortification is the most feasible and cost effective approach, especially in developing countries to overcome nutrient deficiencies. An increased consumer desire for a healthy lifestyle has resulted in demands from the bakery industry for breads containing functional compounds. There is an immediate requirement for the food industry to prepare healthy bakery products to satisfy consumers' health needs [13], [14], [15]. Thus through this project, the importance of millets fortified with different nutritional ingredients have been explored.

From the sensory evaluation analysis, it was noticed that multigrain fortified cookies scored the highest were analysed for nutritional proximate parameters and compared with a commercially product (Table 1). On comparison of the multi grain biscuit with a commercially available biscuit, the multi grain cookies made in this present study was found to be high in energy, protein, fat and fibre content per 100g of the sample. As the dietary fibre helps maintain bowel health and also controls blood sugar levels, the fibre content of the multigrain biscuit could be increased by increasing the quantity of all the minor ingredients.

Table 1 Nutritional Parameters of Highly Scored Product (Multigrain Cookies) and Comparison with Commercial Product

PRODUCT	ENERGY (Kcal/100g)	PROTEIN (g/100g)	FAT (g/100g)	FIBRE (g/100g)
Multi grain fortified cookies	474.41	10.37	12.45	4.50
Commercial	444	4	12	0

From a nutritional point of view, the ethnic and novel products of millets were found to be comparatively richer in protein and mineral content than those made out of rice or wheat. Indeed, since substitution of less refined millet flour to standard recipes, has improved the nutritional quality of the products by increasing macro as well as micronutrients. Recipes based with small millets need to be widely popularized for combating hidden nutritional deficiencies, particularly high among school going children. Value addition also showed to be a highly strategic intervention in the popularization of nutritionally and technologically rich local crops which are currently largely neglected and underutilized [16], [17].

IV. CONCLUSION

Soymilk can be a good source for the development of soymilk based fermented product like yoghurt and further its nutritional value and palatability can be enhanced by fortification. With the increased rise of "Veganism" in India, these products can be a good alternative for daily consumption since it contains all the required nutritional benefits. Processing and utilization of millets in value added product development have promising prospects with regard to nutrition, quality and health benefits and can be an alternative to cereals but its full scope and utilization is yet to be established. Popularization in the broader range is essential and specific design of foods acceptable to the population can help in promoting the consumption of these millets.

From a nutritional point of view, the ethnic and novel products of millets were found to be comparatively richer in protein and mineral content, by increasing macro as well as micronutrients, than those made out of rice or wheat. Recipes based with small millets need to be widely popularized for combating hidden nutritional deficiencies, particularly high among school going children. Value addition also showed to be a highly strategic intervention in the popularization of nutritionally and technologically rich local crops which are currently largely neglected and underutilized.

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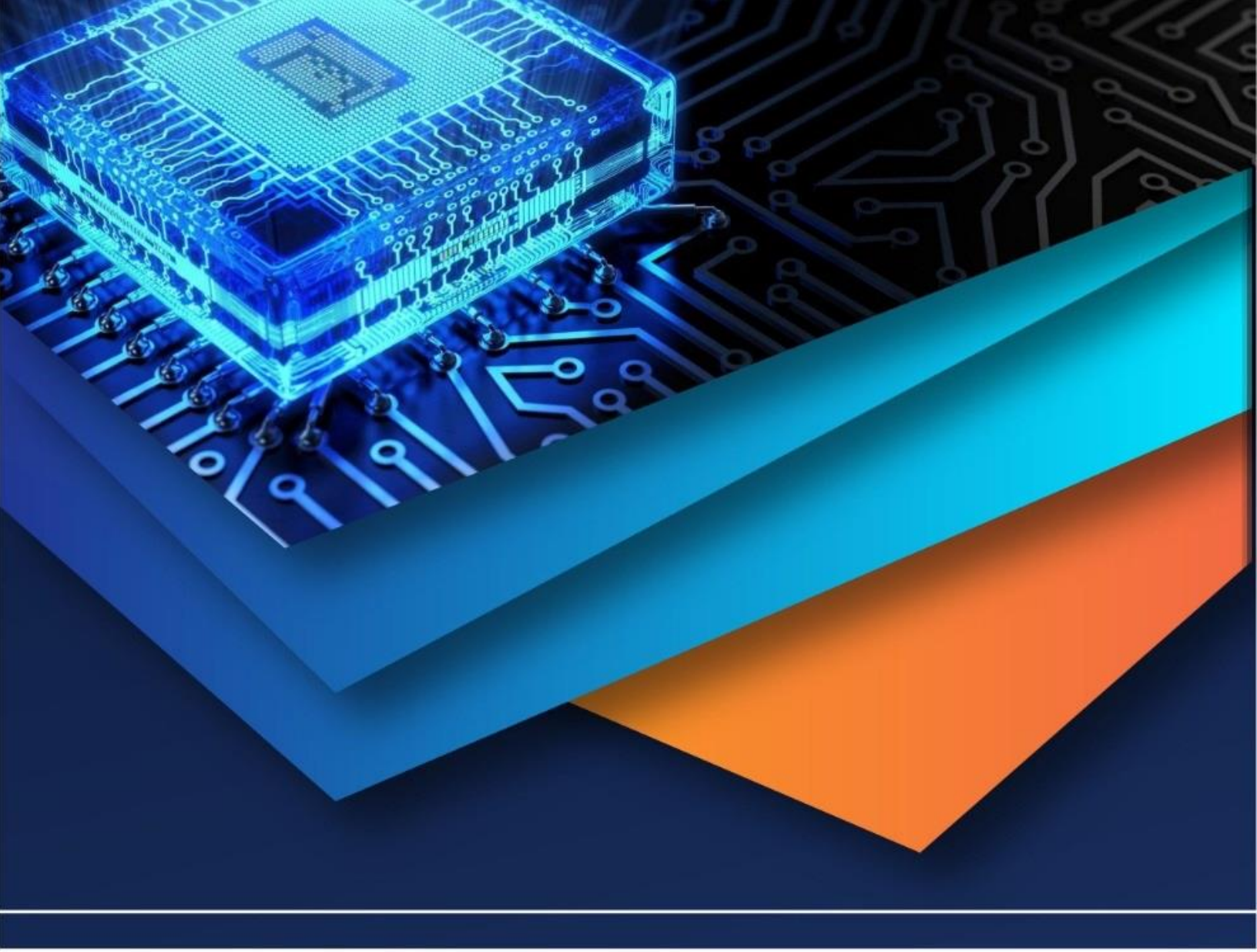

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