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# Comparative Study of Moisture, Crude Fibre, Protein and Mineral Composition in Five Varieties of Cassava (Manihot esculenta Crantz) Tubers

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***Abstract:** A comparative study of moisture, crude fibre, protein and mineral was conducted in five varities of cassava tubers in order to know the nutritional composition present in it. The result of this work shows that the high amount of moisture content is observed in Sree Vijaya (69.81%), where the other varieties like Sree Jaya, Malayan, Swarna and Mulluvadi contains 69.36%, 69.04%, 68.07% and 68.64% of moisture respectively. In case of crude fibre, Sree Jaya contains 2.6%; Malayan contains 2.8% and Swarna of 2.7%. The results of crude fibre shows that comparatively high amount of crude fibre is observed in Sree Vijaya (3%) and least amount in Mulluvadi (2.5%).The protein content is high in Malayan (0.038±0.002 mg/gm) and low in Mulluvadi (0.025±0.004 mg/gm), the Sree Vijaya contains 0.031±0.003 mg/gm, Sree Jaya contains 0.033±0.003 mg/gm, Swarna includes 0.032±0.006mg/gm of protein. The minerals like calcium, phosphorous and iron were analysed in this work. The calcium, phosphorous and iron content in Mulluvadi is 0.04%, 0.09% and 6.3ppm respectively. In Sree Vijaya the amount of calcium is 0.06%, phosphorous is 0.142% and iron is 18.5 ppm. Sree Jaya contains 0.06% of Ca, 0.073% of P and 6 ppm of Fe. The Ca content in Malayan is 0.1%, the P content is 0.1% and the Fe is 9.4 ppm. In Swarna the quantity of Ca is 0.04%, P is 0.104% and Fe is of 13.7 ppm.***

***Keywords:** Cassava (Manihot esculenta Crantz), Moisture, Crude fibre, Protein, Minerals.*

## I. INTRODUCTION

One of the major challenges faced currently is the ever growing gap between food supply and population. A typical proper diet for human includes fruits, vegetables, meat products, milk products, cereals, tubers etc. But about 70-80% of population does not get proper diet because of economic problems. Therefore most of the people depend on locally available food stuffs like root and tubers. Roots and tuber crops are important part of food supply of world. The crops such as yams, cassava, cocoyam and sweet potatoes rank next in importance to the cereal grains in providing the major part of the daily caloric needs of people in the tropics [1]. Cassava (*Manihot esculenta* Crantz) is a woody shrub which comes under the family Euphorbiaceae. The tubers of cassava were extensively consumed as a source of food when compared with other tubers. Cassava is widely used as human feed, livestock feed and various forms of industrial uses [3].

Cassava varieties have high nutritional value due to the presence of carbohydrate. The other nutritional components present in cassava were moisture, crude fibre, protein, minerals etc. In cassava tubers more than 60% of moisture content were observed, moisture is the amount of total water content present in it. The cassava tuber also contains crude fibre, which varies from varieties to varieties. The crude fibre is a kind of dietary fibre, which is usually a measure of the quantity of indigestible lignin, cellulose and other components. There is an increasing drive to include food rich in fibre diet, and on those grounds cassava could be a good source of dietary fibre [8]. Fibre may help to prevent colon cancer [4]. Very low protein content was observed in cassava tubers. About 50% of the crude protein in the roots consists of whole protein and the other 50% is free amino acids (predominantly glutamic and aspartic acids) and non-protein components such as nitrite, nitrate and cyanogenic compounds [5]. The tubers of cassava also contain minor quantity of minerals such as calcium, phosphorous and iron. Minerals are one of the important nutrient which is needed for the growth of body cannot be synthesised by human itself, therefore they extensively depend fruits, vegetables, tubers etc. Cassava also provides minerals including relatively high amount of calcium and iron which are found in higher qualities in some product such as grain than in the raw root [11].

Cassava is also known for having the presence of cyanide content, the study conducted with the same taken variety showed that the tuber named Mulluvadi contains high amount (121.42±0.22µg/gm) of total cyanide when compared with the others, where as it is the tuber of Malayan which contains least amount of total cyanide which is 73.06±0.21µg/gm [12]. The composition of cassava tubers varies depending on some factors such as soil, age of plant, climatic condition, topography etc...The main intension of the

present investigation were to quantitatively determine the amount of moisture, crude fibre, protein and mineral content present in selected five varities of cassava tubers.

## II. MATERIALS AND METHODS

### A. *Study Material*

The selected varieties of cassava for this study are: Mulluvadi, Sree Vijaya (Kariyila poriyan), Sree Jaya (Diwan kappa), Malayan-4 (M-4) and Swarna (Arumasa kappa).

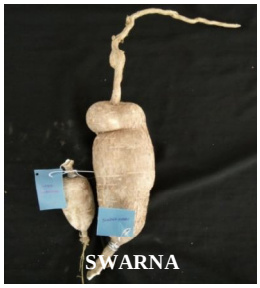
PLATE: 1


PLATE 2


PLATE 3


PLATE 4


PLATE 5




### B. *Collection and Preparation of Sample*

Freshly harvested tubers of cassava namely: Mulluvadi, Sree Vijaya (Kariyila poriyan), Sree Jaya (Diwan Kappa), Malayan 4 (M-4) and Swarna (Arumasa kappa) were collected from the farm of CTCRI (Central Tuber Crop Research Institute), located at Sreekaryam, Thiruvananthapuram, Kerala, India in 2017.

The selected five tubers were washed with distilled water in order to remove soil adhered in it, then it was peeled. The peeled tubers were again washed carefully with distilled water and cut into small pieces separately. The cut samples were oven dried at 40°C for 18h. Using motor and pestle the samples were grounded into fine powder.

### C. *Methods*

*1) Moisture analysi:* Initially an amount of 10 gm of fresh tuber sample was taken. The amount of moisture in the sample was determined by drying it in an oven about 60°C for 72 hours. The dried sample was weighed again after 72 h and the moisture percentage (M %) was calculated.

$$M\ \% = (\text{Fresh weight} - \text{Dry weight} / \text{Fresh weight}) \times 100$$

*2) Crude Fibre analysis:* Two gm of powdered tuber sample was extracted with petroleum ether in order to remove fat. After the extraction with ether the sample was boiled along with 200ml sulphuric acid for 30 min with bumping chips. The solution was filtered through muslin and washed with boiling water until washings are no longer acidic. Then the sample solution was boiled with 200 ml of sodium hydroxide solution for 30 min. The sample solution was washed with 25 ml boilings 1.25% sulphuric acid, three 50 ml portions of water and 25 ml alcohol, after filtering through muslin cloth again. The residue was removed and transferred to ashing dish (preweighed dish). The residue was dried for 2h at 130 ± 2°C. The dish was cooled in a desiccator and weighed. The residue was ignited for 30 min at 600 ± 15°C and cooled in a desiccator and reweighed.

*3) Protein analysis:t*gm of sample was weighed and mixed thoroughly in phosphate buffer. The sample solution was filtered out by using cheese cloth. Then the filtrate was centrifuged at 5000rpm for 10 minutes. The supernatant was collected and made it to known volume by using buffer. 1ml of the above solution was taken and into the solution 1ml of 10% TCA was added. Then the solution was shaken thoroughly. It was kept in freezer for 15 minutes and centrifuged at 10,000 rpm for 10 minutes. The upper layer was decanted; from this the pellet was carefully taken. It was dissolved into known volume of 0.1 N NaOH. 0.1 ml of aliquot was taken from it. The solution was made up to 1ml by using 0.1 N NaOH. 5ml of reagent C was added into it. The mixture was kept for 30 minutes. The OD was read at 670nm.

*4) Mineral analysis:*The mineral content was determined by di acid digestion method. One gram of powdered tuber sample was placed in a 100 ml conical flask. To this 10 ml of acid mixture (9:4 mixture of $HNO_3$ and $HClO_4$) was added and the content of the flask was mixed by swirling. The flask is placed on a hot plate at low heat in a digestion chamber. Then the flask is heated at high temperature until the production of red fumes ceases. The contents are further evaporated until the volume is reduced to about 3-5ml. the completion of digestion is confirmed when the liquid become colourless.

After cooling the flask, 20 ml distilled water was added and the solution was transferred to 100ml volumetric flask and made up to volume. The solution was filtered and the aliquots were taken from this for determination of calcium, phosphorous and iron.
The calcium content was determined by direct titration with EDTA disodium salt solution with the help of a metal ion indicator. The total phosphorous concentration was determined by vanado molybdo phosphoric yellow colour method in nitric acid system. Iron content was measured using AAS.

## III. RESULTS AND DISCUSSION

The results of moisture, protein, crude fibre and mineral coposition of the five varities of cassava tubers which was analysed are presented here. The quantitative result of moisture crude fibre and protein is shown in Table.1.

TABLE:1. Results of Moisture, Crude Fibre and Protein in Five Varieties of Cassava Tubers

| Parameters | Mulluvadi | Sree Vijaya | Sree Jaya | Malayan | Swarna |
|---|---|---|---|---|---|
| Moisture (%) | 68.64 | 69.81 | 69.36 | 69.04 | 68.07 |
| Crude fibre (%) | 2.5 | 3.0 | 2.6 | 2.8 | 2.7 |
| Protein (mg/gm) | 0.025±0.004 | 0.031±0.003 | 0.033±0.003 | 0.038±0.002 | 0.032±0.006 |

The moisture content in the tubers of five varieties of cassava is shown in Table: 1 and Figure: 1. The study shows that the cassava variety Sree Vijaya contains greater amount of moisture content (69.81%) than that of the other varieties. The lowest moisture content is observed in Swarna which is of 68.07%. The moisture content of other cassava varieties such as Mulluvadi, Sree Jaya and Malayan are 68.64%, 69.36% and 69.04% respectively. This study shows that the average moisture content in the cassava varieties could be of 68-70% which authenticate to the work of Montagnac et al., [9] which showed that average moisture content in cassava tuber ranges between 45.9 to 85.3%. The work of Schoeninger *et al.*, [13] determined the composition of tubers, were they proved that the cassava tuber posses 62% of moisture content. Varieties with low moisture content would be suitable for prolonged root storage [16].
This study analyzed the crude fibre content of the selected varieties of tubers and the results are presented (Table: 1 and Figure: 1). Sree Vijaya contains high amount of crude fibre which is 3.0 % when compared to other four cassava varieties. Least amount of crude fibre is found in Mulluvadi (2.5%) than the others. The tubers of Cassava such as Sree Jaya, Malayan and Swarna are 2.6%, 2.8% and 2.7% respectively. The study shows only a narrow difference in the crude fibre content in the examined varieties. The earlier works [7] showed that the crude fibre is 5.66±0.02% in sweet cassava variety as compared with 4.13±0.02% for the bitter cassava variety and the work of Anbuselvi and Balamurugan [14] also showed that the crude fibre in the tuber of cassava were 4.0%, which is imperceptibly different from the present study. The slight variation of the results of the current work may be because of difference in number of factors such as natural variation of the tubers and geographical origin that may influence the nutrition composition of the cassava tuber. Sarkiyayi and Agar [15] also shows that the crude fibre in the bitter cassava and sweet cassava tubers are 4.61% and 4.40% which is in concordance with the present study.

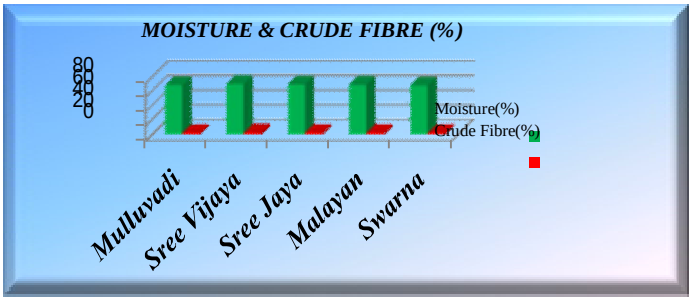



Figure: 1. Moisture and crude fibre content of cassava varities in %

The protein content in the five varieties of Cassava tubers were shown in the Table: 1 and Figure: 2. The current study shows that only a small amount of protein present in the cassava tubers. Of the varieties studied, the Malayan tuber contains comparatively high amount of protein (0.038±0.002 mg/gm) than the other Cassava varieties, whereas least amount of protein is in Mulluvadi tuber (0.025±0.004 mg/gm). The protein content in Sree Vijaya, Sree Jaya and Swarna are 0.031±0.003 mg/gm, 0.033±0.003 mg/gm and 0.032±0.006 mg/gm respectively. The result of protein in the current work can be compared with the earlier works [10] where the observed about 1.5 mg/100 g of protein in fresh mass and about 1 to 3% of protein in dry matter [2]. Ceballos *et al.* [6] suggested that the wide range of protein values found in their study (0.95% - 6.42%) were genetic in nature and provide excellent opportunities for the improvement of protein levels through conventional breeding methods.

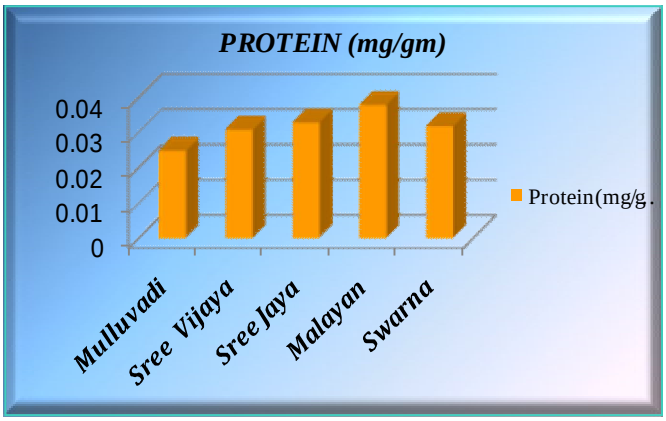



Figure 2. Showing the protein content (mg/gm) in the tubers of cassava varities

The minerals such as calcium (Ca), phosphorous (P) and iron (Fe) were analysed in the current work. The result of mineral composition of the selected cassava tuber varieties are shown in the Table: 2 and the data are also shown in the Figure: 3 and 4. There was no significant difference is observed in the calcium and phosphorous content in the selected varieties of cassava tubers but iron level was significantly differ among the tuber samples.

TABLE:2 Results of Minerals (Ca, P& Fe) in Five Varieties of Cassava Tubers

| Minerals | Mulluvadi | Sree Vijaya | Sree Jaya | Malayan | Swarna |
|---|---|---|---|---|---|
| Calcium (%) | 0.04 | 0.06 | 0.06 | 0.1 | 0.04 |
| Phosphorous (%) | 0.09 | 0.142 | 0.073 | 0.1 | 0.104 |
| Iron (ppm) | 6.3 | 18.5 | 6.0 | 9.4 | 13.7 |

The present study shows that there is only a minute difference in Ca composition among the varieties of Cassava tubers (Table: 1& Figure: 3), where relatively high amount of Ca is present in Malayan which is 0.1% compared to other varieties. The cassava varieties such as Sree Jaya and Sree Vijaya have comparable amount of Ca content (0.06%). Similar result is repeated in the case of Mulluvadi and Swarna where both the tubers shares same amount of Ca content (0.04%). The obtained result were comparable with the study conducted by Sarkiyayi and Agar [15] where the calcium content of the sweet cassava variety is 33 mg/100g and in bitter cassava contains 30 mg/100g of Ca.

The Table: 1 and Figure: 3 shows the amount of Phosphorous (P) present in the selected cassava tubers. Comparatively higher amount of Phosphorous (P) is seen in the Sree Vijaya (0.142%) and least amount in Sree Jaya which is of 0.073%. The other Malayan possess medium amount of P (0.1%). The P content in Mulluvadi and Swarna are 0.09% and 0.104% respectively. The earlier study of Omosuli, [17] observed that the phosphorous content in raw cassava (0.038±0.004%) is lower than that of boiled cassava tuber (0.042±0.004%). Table:1 and Figure:2 shows the details of the Phosphorous content in the varities of cassava tubers.

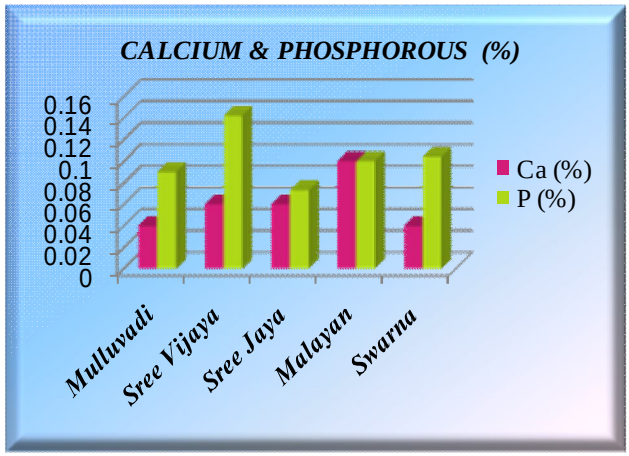



Figure: 3, Showing Mineral content (Ca& P) of the tubers of cassava varities in %

The quantitative estimation of Fe in the samples was determined by AAS method. The results are given in Table: 1 and Figure: 4. In this work , a much more variation is seen in the Fe content among the tuber samples when compared with the other two minerals like Ca and P. Sree Vijaya contains grater amount of Fe (18.5ppm) where as the tubers of Sree Jaya contained the least quantity of Fe (6ppm). The content of Fe was 13.7 ppm in Swarna and the tuber sample of Mulluvadi and Malayan posses 6.3ppm and 9.4ppm of iron. Sarkiyayi and Agar [15] (2010) found that in the iron content in the sweet cassava varitiey is 30±0.11 mg/100gm and in bitter variety 18±0.30 mg/ 100mg. The study conducted by Montagnac et al., [9](2009) found out that iron in raw cassava were 0.27 mg/100gm and the iron content in the cassava roots ranges from 0.3 to 14.0mg/100gm.


Figure:4, Showing the iron content (ppm) in the selected cassava tubers

## IV. CONCLUSION

Tubers are one of the important part in human diet. Due to their easily availability and low cost local community greatly depend on the tuber crops. Among that, the tubers of cassava (Manihot esculenta Crantz) were used extensively when compared with other tubers. One of the important features of cassava is their ability to tolerate drought and low fertile soil. The tubers of cassava is also rich with nutritional components such as carbohydrates, moisture, crude fibre, protein , minerals etc...Among these carbohydrate and moisture together contribute more than 80% of the total composition of the tuber. The remaining includes other minor nutrients and some other anti nutritional components. The chemical composition of the cassava tuber may varies depending on soil, climatic conditions, topography etc...

The present investigation gives a scenario on the fact that the amount components in the cassava tubers may varies according to the varities. Among the five selected varities of cassava tubers, the tuber named Sree Vijaya shows comparatively high amount of moisture, crude fibre and minerals like phosphorous and iron , and the higher amount of protein and calcium is observed in the

Malayan tuber. The least amount of crude fibre and protein were observed in the tuber named Mulluvadi when its compared with the other varities. Swarna contains least amount of moisture whereas the tuber of Sree Jaya contains lower amount of phosphorous. The study showed that, the cassava tubers can be included in the diet of human and other animals, but only properly processed as well as cooked cassava tuber should be taken for consumption otherwise due to the presence of certain anti-nutritional components like hydrogen cyanide it can be fatal to life.

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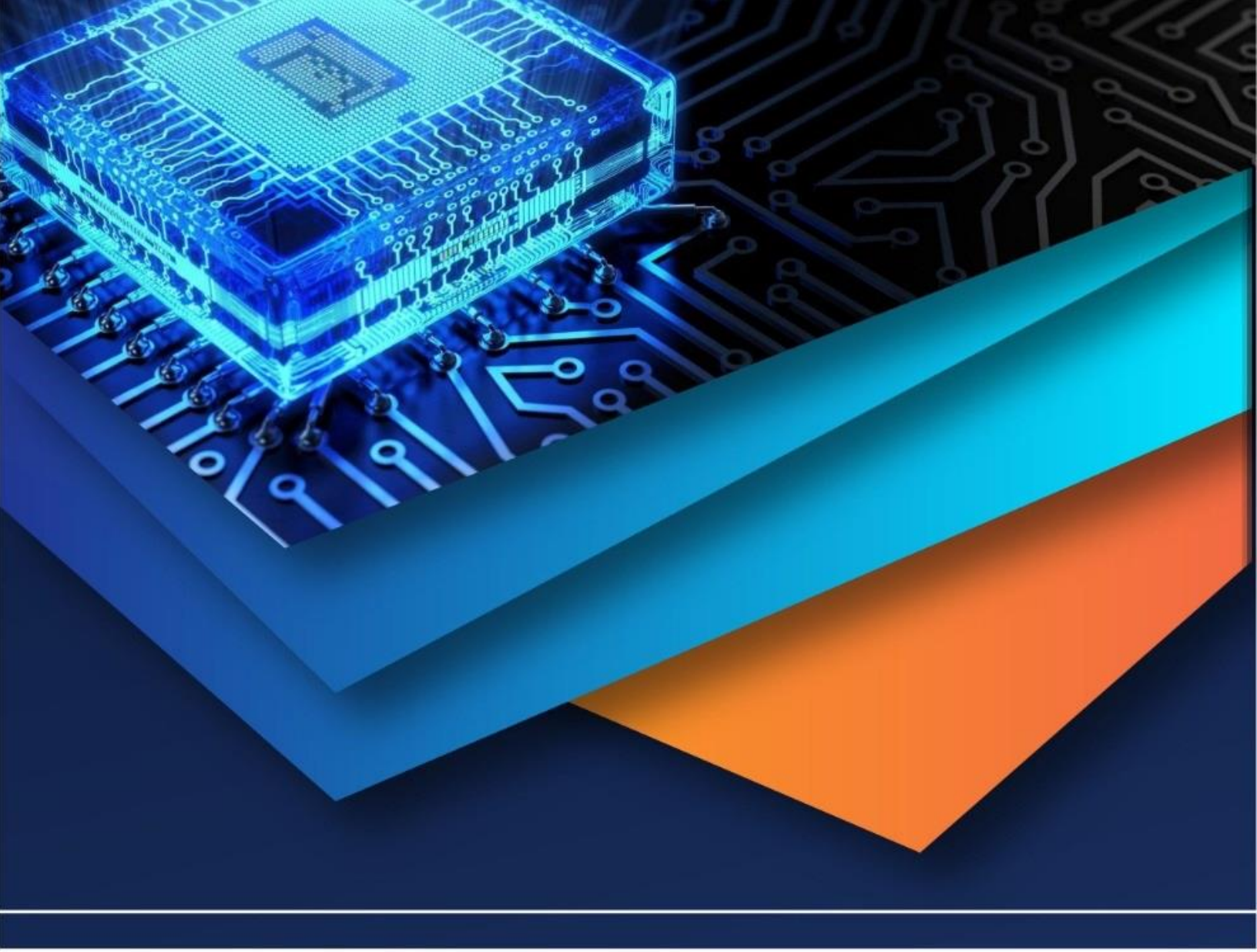

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