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Different Agricultural Wastes as Substrates for Growth and Production of *Pleurotus florida*

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Abstract: The present study was done impact of agricultural wastes on growth and production by oyster mushrooms i.e., Pleurotus florida which have a rich source of protein and also has important medicinal properties. The yield and Biological efficiency of different lignocellulosic agricultural wastes viz. Wheat straw, Maize leaves, Cob leaves, Jawar residue, Bajra residue, Bamboo leaves, Paddy straw, Sugarcane, Cotton, Soyabean, Safflower (Pods residue), Pigeon pea (Pods residue), Mung bean (Pods residue), Cowpea (Pods residue). the paddy straw showed the highest yield 892.25 gm with the highest biological efficiency 89.09 % followed by Cowpea pods residue gives 879.65 gm yield of Pleurotus florida and shows biological efficiency of 87.72%, followed by Wheat straw substrate showed 871.18 gm yields with 87.27 % biological efficiency. The Pigeon pea pod residue showed 865.85 gm yield during three harvestings having 86.36% biological efficiency. Similar result was seen Bajra residue and soybean pod residue in bajra residue showed 792.45gm yield during three harvestings having 79.245% biological efficiency, in soybean pod residue showed 791.63 gm yield during three harvestings having 79.163 % biological efficiency. The lowest yield was seen in Bamboo leaves and cotton residues. In cotton residue substrate 433.22 gm total yield along with 43.32% biological efficiency, Bamboo leaves substrate total yield were seen 438.12gm with 43.81 % biological efficacy.

Keywords: Pleurotus florida, Agricultural waste, Substrates, Biological efficiency

I. INTRODUCTION

The Oyster mushroom grows during winter months only therefore, it needs proper preservation techniques to promote their consumption among common people and excess mushroom is processed into food products acceptable to consumers. Mushrooms contain 90 percent moisture. Oyster mushroom (Pleurotus sp.) belonging to Class Basidiomycetes and Family Agaricaceae is popularly known as 'Dhingri' in India and grows naturally in the temperate and tropical forests on dead and decaying dried trees or sometimes on dying trunks of wood blocks. It may also grow on decaying organic matter. Produces protein-rich food Oyster mushrooms are the third largest cultivated mushroom Sonali {24}.

They are a promising resource of physiologically functional food and as material for the development of medicines, pharmaceutical products, such as drugs, dietary supplements and healthy cosmetic products. Dhingri have very high content nutritional value being rich in proteins, vitamins and minerals. Mmushroom fruiting body have nutrients and other essential compounds, such compounds were obtained for making of drugs, dietary supplements and healthy cosmetic products Zhong and Tang [1]. The mushroom were a rich source of protein and are used as a substitute for meat in vegetarian diets. It has been reported by Stanely and Odu [2]. Mushroom are high in nutritional but are low in caloric value and hence are recommended for heart and diabetic patients. They are high content of proteins as compare to cereals, fruits and vegetables. In addition to proteins (3.7 %), they also contain carbohydrate (2.4 %), fat (0.4%), minerals (0.6 %) and water (91%) on fresh weight basis. All essential nine amino acids which are required for human growth present in Mushrooms. Mushrooms are an outstanding source of thiamine (vitamin-B1), riboflavin (B2), niacin, pantothenic acid, biotin, folic acid, vitamin C, D, A and K which are retained even after cooking. Since mushrooms possess low caloric value, high protein, high fiber content and high K: Na ratio, they are ideally suited for diabetic and hypertension patients. They are also reported to possess anticancer activities [3], [4], [5] and [6].

An attractive feature of this group of mushrooms is that they can utilize a large variety of agricultural waste products and transform lignocellulosic biomass in food of high quality, flavor and nutritive value. In world mushroom production, *Pleurotus* rate second, after *Agaricus biosporus*. In 1986, *Pleurotus* sp. Production accounted for approximately 7% of the total world production of edible mushrooms. By 1990, production of *Pleurotus sp.* reached one million metric tons and accounted for 24% of total mushroom production. The lignocellulosic materials, like waste from farming, forest, the cotton industry and plant woods can be utilized for mushrooms cultivation [7], and [8].

Different species have been grown on sawdust acquired from various tree species with an assortment of added substance for example wheat bran, cornmeal, cereal grains, and other organic materials. A few substrates additionally contain mineral added substances, generally as gypsum as well as chalk. The conventional use of substrates made up of different mixtures of various resources is more favorable for the yield. Than the use of same substrates due to the enhanced nutritional environment [9] and [10]. Chang and Buswell, [11] in his work alpha-cellulose, hemicellulose and lignin influence the higher rate of mycelium running in corn cobs and palm cones for that utilization of insoluble lignocellulosic substrates by edible mushrooms depends on the production of the enzymes such as cellulases, hemicellulases, ligninases which bring about hydrolysis of the macromolecules of cellulose, hemicellulose and lignin components of the substrate, the low molecular weight nutrients essential for growth of mushroom. In another study, sawdust acting as a substrate gave the lowest mycelium running rate, which might be due to the presence of different kinds of polyphenolic substances in them as suggested by [12] and low content of cellulose [13]

Mushrooms are fungi, which lack chlorophyll and not able produce their food in the presence of sunlight as like green plants, however, the mushroom can produce a wide range of enzymes that degrades the complex substance on which they grow, and absorb the soluble substances for their nutrition. Mushrooms can plays important role in economic growth of society. Mushroom is good alternative for traditional horticultural crop having a high quality of nutritional value. The world produces 61.16 lakh of cultivated mushrooms annually. Pleurotus species need a short span for growth. Its fruiting body is not easily attacked by pests and diseases and *Pleurotus* species can be grown modestly and inexpensively, sporelessness, having high yield, which are wider utilization substrate, as well more tolerance to chemical, temperature, and environmental bioremediation [14]. Paddy straw mushroom (*Pleurotus florida*) is an edible mushroom of the tropic and sub-tropic regions. Most of the palatable fungi have a solid protein framework and are fit for using complex natural mixtures, present in agricultural wastes and industrial products. Numerous industrialized and farming by-products are vital in mushroom production including, wood chips, espresso mash, and teff straw, and cotton waste has huge lignin, cellulose, and hemicellulose substances [15]. Oyster mushrooms can grow at a moderate temperature ranging from 20 to 30^0 C and humidity 55-70% for a period of 6 to 8 months in a year. The appropriate season for cultivation is summer months by give additional humidity for its growth in hilly areas which were above 900 m., the best growing season is during March/April to September/October and in the lower regions from September/October to March/April. In this study, we are going to observe the growth of *Pleurotus florida* on the high potential of different Agricultural wastes, Biological efficiency of the same species on different agricultural substrates which is need to identify alternatives for sustainable cultivation of oyster mushrooms.

II. MATERIAL AND METHODS

A. Cultivation of Pleurotus florida

The cultivation of Oyster mushroom or *Pleurotus* spp is relatively simple. The agro-climatic conditions in our country especially in the Indian States are conducive for mushroom cultivation when the temperature is 15-30^0C and relative humidity is 70-80%. The production decreases during peak periods of winter [3].

1) *Substrate:* The mushroom laboratory at Department of Botany, Dr. Babasaheb Ambedkar Marathwada University Aurangabad – 431004 (MS) India. Mushroom (*Pleurotus florida*) culture and prepared spawn were the selection of mushroom, production of the subculture, production of mother spawn, and production of grain spawn as outlined in the method presented by Zied et al. [16]. The different organic wastes used as substrates viz. Wheat straw, Maize leaves, Cobe leaves, Jawar residue, Bajra residue, Bamboo leaves, Paddy straw, Sugarcane, Cotton, Soybean, safflower (Pods residue), Pigeon pea (Pods residue), Mung bean (Pods residue), Cowpea (Pods residue), were sterilized with Bavistin (Carbendazim 50% WP (75.ppm)**,** Formaldehyde (37-40%) the substrates were then drained to remove excess water and packed into transparent plastic standard with 14 x 22 cm size for mushroom cultivation (Photoplate no.1) .
2) *Bag filling Method:* The bag filling method was used throughout the studies (Photo plate no. 1). The polythene bags of 14 x 22 cm and the bottom of the bags were tied with rubber to provide a flat circular bottom to the mushroom beds. The dry weight of the substrates was recorded and the bags full of different substrates were weighed and were maintained at 1 kg. in a bag for each substrate. The first layer was filled with the substratum up to 5 cm in height. The spawn was sprinkled over the entire surface of the substratum. Similarly, four such layers were filled with the substratum. Inoculation was made with pure grain spawn at 10 grams per kg of the substrate on a dry weight basis under aseptic conditions. The bags were tied and two vents of one cm diameter were provided.

3) *Climate & other Conditions:* In the fruiting house, the bags were put on the wooden racks, water was sprayed onto the bags to keep them moist, the floors were also wetted to help increase the humidity to not less than 85.0%, were mentioned at culture room

Photo plate no. 1. Procedure for Bed Preparation

Sterilization of substrates

Water dragging

Fumigation

Layer spawning Bed and Pining

4) *Harvesting:* As soon as the fruiting bodies developed and attained their full size, they were cut just above the surface of the substrate with a sharp knife or blade. Scrape out 1 cm outer layer of the bed after the first harvest and do not sprinkle water for 12 hours. From the second day onwards sprinkle water. Within 3 to 4 days basidiocarps develop.
5) *Yield and Biological efficiency (B.E.):* The total weight of all the fruiting bodies harvested from all three pickings was measured as the total yield of mushrooms. The biological efficiency (yield of mushroom per kg substrate on dry wt. basis) was calculated by the following formula [17].

$$\text{B. E (\%)} = \frac{\text{Fresh weight of Mushroom}}{\text{The dry weight of the substrate}} \times 100$$

III. RESULT AND DISCUSSION

Present work was undertaken to find suitable substrates from the different agriculture waste for Oyster mushroom Growth and Yield. Different five types of substrates were investigated to determine Yield/ Growth and development of *Pleurotus spp*. find out the best substrates for getting more economic benefit. Effect of different substrates viz. Wheat straw, Maize, cob leaves, Jawar, Bajara, Bamboo leaves, Paddy straw, Sugarcane bagasse, Cotton were studied for mycelial growth of *Pleurotus florida* and results were seen from Table No.1 and photo plate No. 2. It was clear from Table No. 1 shows comparative mycelium growth of *Pleurotus florida* concerning no. of days. Observation of mycelial growth along different substrates was taken in 5 days, 10 days, 15 days & 20 days of time interval respectively. It was clear from the table Maize leaves, Cob leaves, Paddy straw, Sugarcane bagasse have shown the highest mycelium growth in a short duration of time ie. 10 -13 days as compared to other substrate like wheat straw, bajra, jawar, Bamboo and Sugarcane bagasse mycelium growth of *Pleurotus florida* lowered.

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Table No. 1. Effect of Substrates on Mycelium growth of *Pleurotus florida*

Sr. No	Substrates	Growth in Days				Days for First Pin Head
		5	10	15	20	
1	Wheat straw	-	-	++	+++	24 Days
2	Maize leaves	+	++	++	+++	21Days
3	Cob leaves	+	++	+++	+++	20 Days
4	Jawar residue	-	+	++	+++	21 Days
5	Bajra residue	-	+	++	+++	24Days
6	Bamboo leaves	-	+	++	+++	25 Days
7	Paddy straw	+	++	+++	+++	16 Days
8	Sugarcane	+	+	++	+++	20 Days
9	Cotton	-	+	++	+++	24 Days
10	Soybean	-	++	++	+++	19 Days
11	Kardai (Pods residue)	-	+	++	+++	22 Days
12	Pigeon pea (Pods residue)	+	++	+++	+++	19 Days
13	Mung bean (Pods residue)	-	++	++	+++	21 Days
14	Cowpea (Pods residue)	+	++	++	+++	19 Days

Photo plate no.2. Effect of different substrates on mycelial growth

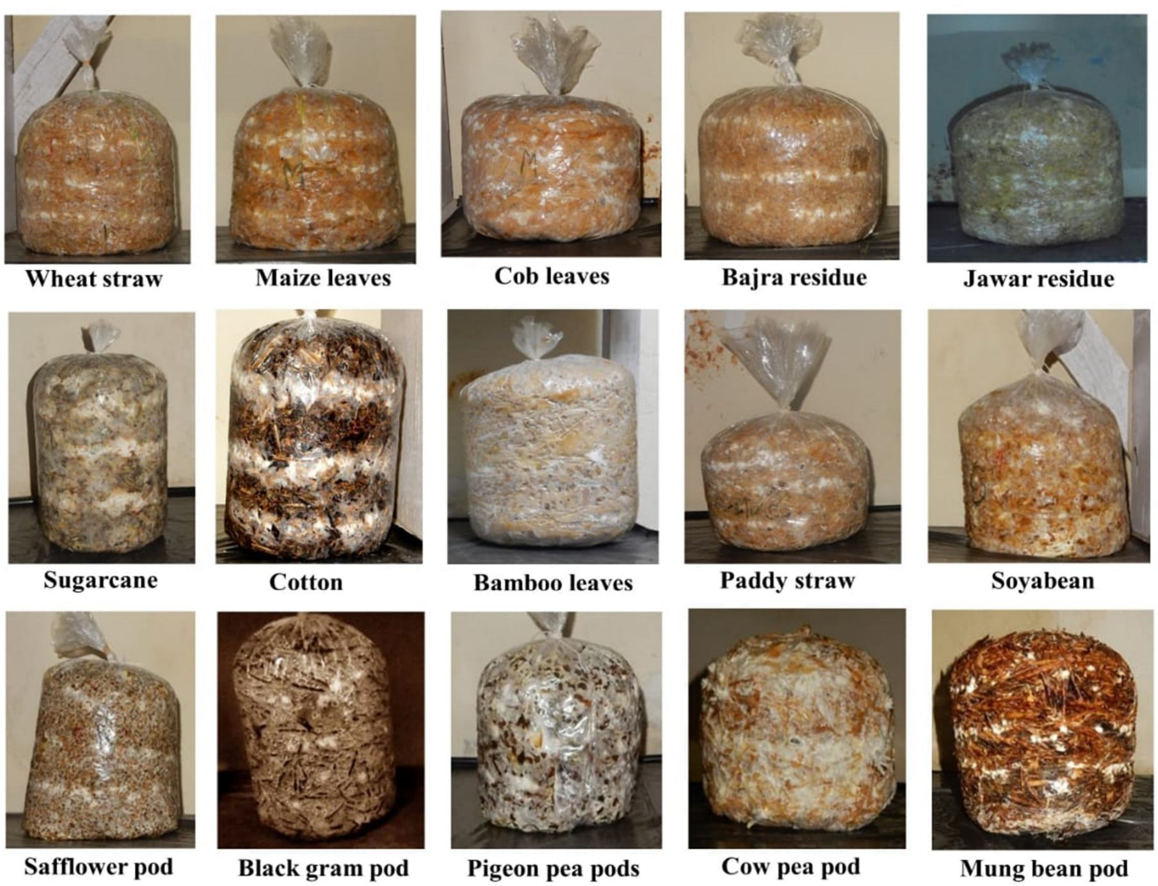
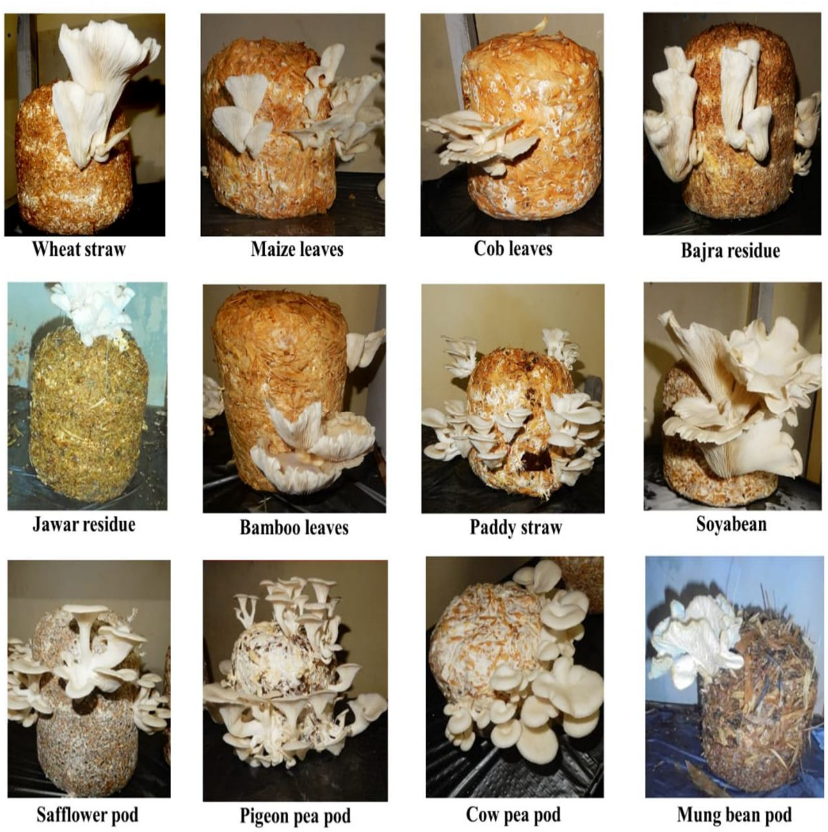


Table No.2. Effect of substrates on yield and Biological Efficiency of *Pleurotus florida*

Sr. No	Substrates	Yield (gm/1 kg of Dry substrates) I	II	III	Total Yield (gm)	Biological Efficiency (%)
1	Wheat straw	437.54	325.98	107.56	871.18	87.118
2	Maize leaves	340.24	188.92	102.05	631.21	63.121
3	Cob leaves	317.32	168.35	76.57	562.24	56.224
4	Jawar residue	366.25	289.24	55.91	711.4	71.14
5	Bajra residue	405.3	287.32	98.83	792.45	79.245
6	Bamboo leaves	237.69	113.54	86.89	438.12	43.812
7	Paddy straw	457.64	327.32	104.29	892.25	89.225
8	Sugarcane	366.25	180.11	89.64	636	63.6
9	Cotton	217.12	140.30	75.80	433.22	43.322
10	Soybean (Pods residue)	345.5	270.05	176.08	791.63	79.163
11	Safflower (Pods residue)	304.3	175.09	81.21	560.55	56.055
12	Pigeon pea (Pods residue)	460.18	302.58	103.09	865.85	86.585
13	Mung bean (Pods residue)	320.2	201.1	89.12	610.42	61.042
14	Cowpea (Pods residue)	465.56	305.97	108.12	879.65	87.965

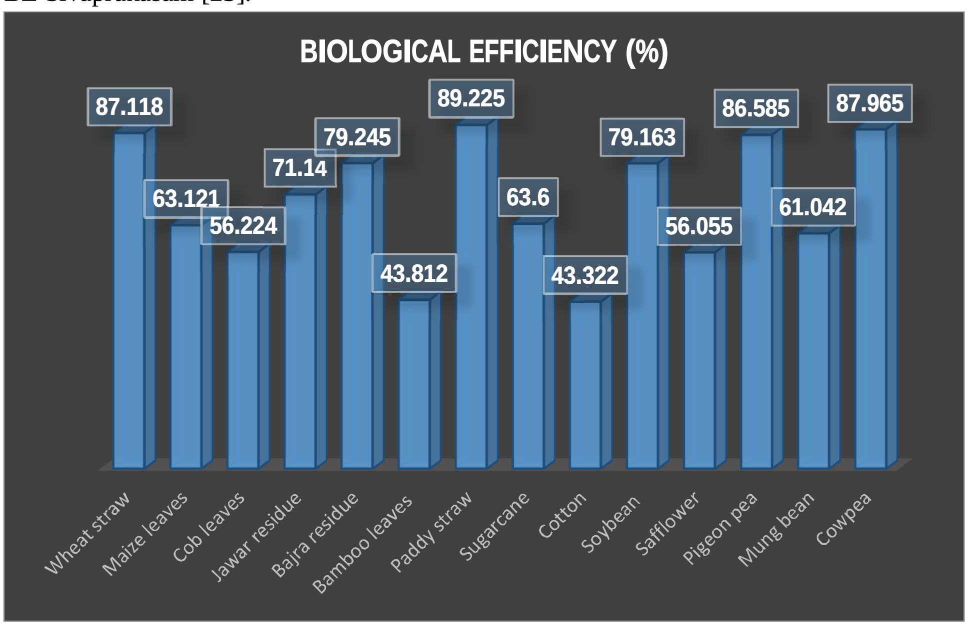
Photo plate no.3. Effect of different substrates on yield



A. Effect of Substrates on Yield and Biological Efficiency of Pleurotus florida

It is cleared from the table impact of different lignocellulosic substrates also plays an important role in the Yield and biological efficiency of oyster mushroom *Pleurotus florida* from Table no.2 and Photo plate number 3.

During the study, the impact of the substrate on yield and Biological efficiency of different lignocellulosic agricultural wastes the Paddy straw, wheat straw, Cowpea (Pod residue), Pigeon pea (Pod residue), Bajra, Jawar substrate and sugarcane bagasse substrate. Among all those substrates the paddy straw showed the highest yield of 892.25 gm with the highest biological efficiency 89.09 % followed by Cowpea pods residue gives 879.65 gm yield of *Pleurotus florida* and shows biological efficiency 87.72%, followed by Wheat straw substrate showed 871.18 yields with 87.27 % biological efficacy. The Pigeon pea pod residue showed 865.85 gm yield during three harvestings having 86.36% biological efficiency. A similar result has seen Bajara residue and soybean pea pod residue in bajara residue showed 792.45gm yield during three harvestings having 79.245% biological efficiency, in soybean pod residue showed 791.63 gm yield during three harvestings having 79.163 % biological efficiency. The lowest yield was seen in Bamboo leaves and cotton residue. In cotton residue substrate 433.22 gm total yield along with 43.32% biological efficiency, Bamboo leaves substrate total yield were seen 438.12gm with 43.81 % biological efficacy. Paddy straw yield with highest biological, to be effective for primordial induction in *Pleurotus* species. [18]. reported that SB contained cellulose and sucrose which are easily degraded by oyster mushrooms and provide energy for mushrooms. The result was in agreement with Philippoussis [19] who stated that the yield of medicinal mushroom (*Lentinula edodes*) grown on CC was higher than that on wheat straw and oak wood SD. Wang et al. [20]. Showed that there was a positive correlation between BE and degradation of cellulose and hemicellulose whereas a negative relationship between BE and lignin degradation was observed. Philippoussis et al. [21] also reported that there is a strong negative correlation between mushroom yield (mushroom number and BE) and the C/N ratio of a substrate. [22]. indicated that cellulose-rich in organic substances was one of the best substrates for the cultivation of oyster mushrooms. Substrates with high lignin and phenolic content decreased the activity of cellulose, but less lignin would enhance enzyme activity and thus ensure higher mushroom yield and BE Sivaprakasam [23].



IV. CONCLUSION

The different types of agriculture waste can be used as substrates used for mushroom production also give excellent yield and biological efficiency. It was a positive thing for me to have more or less mushroom production on almost all agro waste. Generally, Some of the agricultural substrates in the list that were not I concluded that we can grow mushrooms without any hassle on any Agricultural waste and benefit the environment by strengthening sustainable agriculture.

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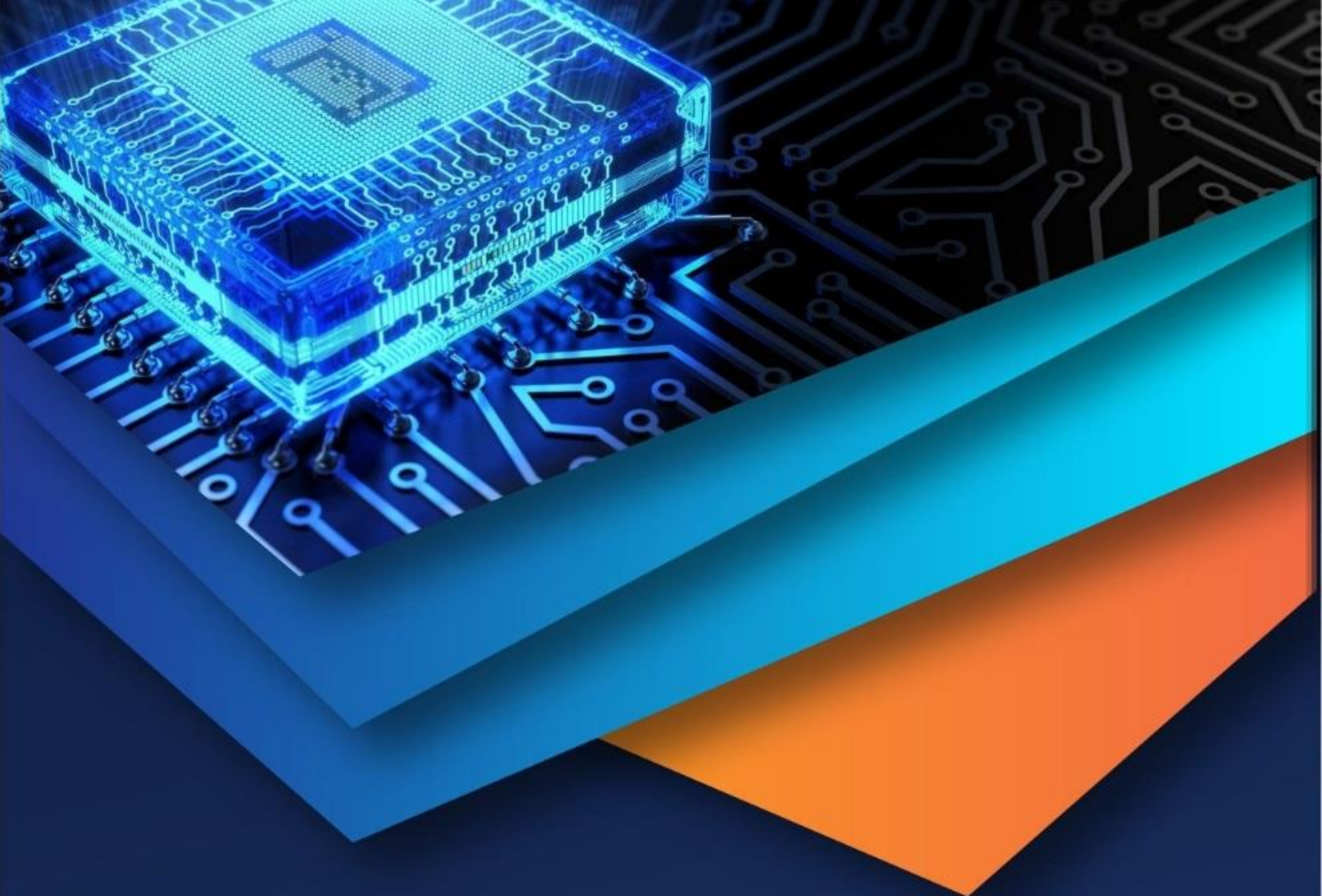

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