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Research of the Anti-Fictional Characteristics in Persea (Avocado): A Review Study

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ABSTRACT
Natural products are being used towards pathogenic microbes since the discovery of penicillin. However, there has been increase in the frequency of microbes that are multi-antibiotic resistant which demonstrates that novel antibiotics are now much needed. Antibiotic resistance acts by changing the target of antibiotics, by increasing the efflux of antibiotic & by degrading the antibiotic itself. In this regard, this paper has attempted to evaluate the antimicrobial property of the avocado oil. Firstly, the oil was obtained commercially and the paper discs were laced with increasing amounts of it & then kept on a lawn culture of Candida albicans & Saccharomyces cerevisiae. The results were observed for 24 hours &Cyclohexamide was taken as positive control. After 24 hours, Cyclohexamide showed highest zone of inhibition while the increasing amount of the oil also showed good inhibition. This thereby opens up the possibility of procuring anti-fungals or even antibiotics from this oil commercially.

Keywords
Antibiotic Resistance, Avocado Oil, Candida Albicans, Cyclohexamide, Paper Disc Assay, Saccharomyces Cerevisiae, Zone of Inhibition.

1. INTRODUCTION
One of the important achievements of humans recently has been the discovery along with the production of the antibiotic, penicillin. Unfortunately, due to the unhindered usage the global supply of such antibiotics has severely weakened owing to increase in microbial antibiotic resistance [1]. Since the introduction of penicillin, products of natural origin have guided the evolution of antibiotics. The dependence on products of natural origin to produce new molecular agents for nearly every disease has also been well reported. Among the 9 classes antibiotics (Figure 1) 6 symbolizes naturally occurring agents, only three (the sulfonamides, oxazolidinones & fluoroquinolones) synthesized entirely via synthetic chemistry. There is an immense structural variety along with complexity in the natural product based antibiotics with respect to synthetic agents [2].

Within the bacteria cells, antibiotics have 3 main targets, with each antibiotic class having one unique manner of action. These targets involve the prevention of [1] synthesis of cell wall [2]synthesis of protein [3] Nucleic acid synthesis (Figure 2). Firstly, the β-lactams, along with cephalosporin, prevent the transpeptidation coupling action of peptidoglycan, acting as precursor for cell wall formation. Secondly, many antibiotic classes prevent protein formation in the ribosome of the bacteria. The third main target is the nucleic acid replication and its repair. Moreover, the sulfonamide drugs targets folic acid routes in bacteria (Figure 3). Based on these factors, it has become important for new antibiotics to be discovered. In this paper, the oil of the Avocado was evaluated for its anti-microbial properties. The various classes of antibiotics are as follows: [1] ß lactams [Penicillin G], [2] tetracycline [3] macrolides (erythromycin) [4] glycopeptides (vancomycin) [5] aminoglycosides (gentamycin) [6] Lincosamides (clindamycin) [7] sulphonamides (sulfamethizole) [8] oxazolidinones (linezolid) [9] fluroquinolones (ciprofloxacin). In Figure 1, the mode of action of classes of antibiotics has been illustrated. In Figure 2, the mode of antibiotic resistance has been illustrated [1].

As the incidence of antibiotic resistance is increasing worldwide, researchers are now focusing on plants that are frequently consumed by humans to be a source for novel anti-microbial agents.

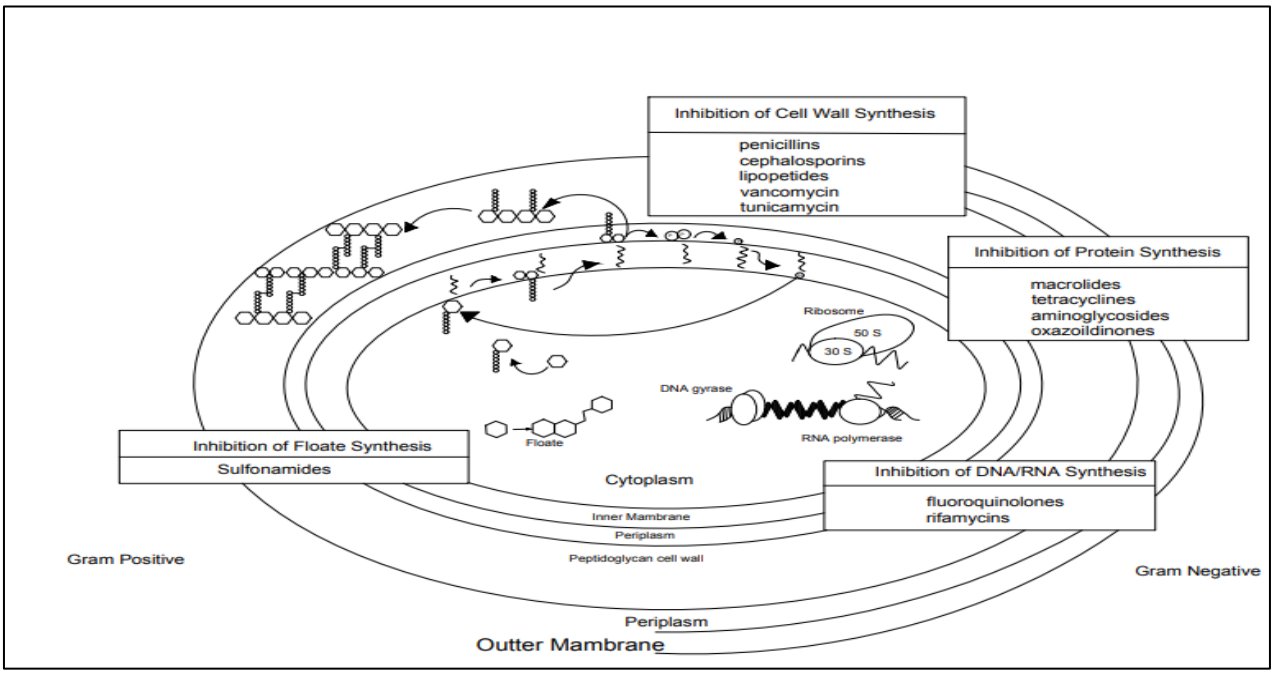

Figure 1: Illustration of 3 main modes of function of the commonly used antibiotics, including sulfa drugs.Like, [1] the prevention of cell wall formation by penicillin, lipopeptides, cephalosporins, tunicamycins&vancomycin [2] prevention of protein formation by macrolides, aminoglycosides, tetracyclines&oxazolidinones [3] preventation of nucleic acid synthesis by rifamycins&fluroquinolones [4] prevention of biosynthesis of Folate by sulphonamides[3]

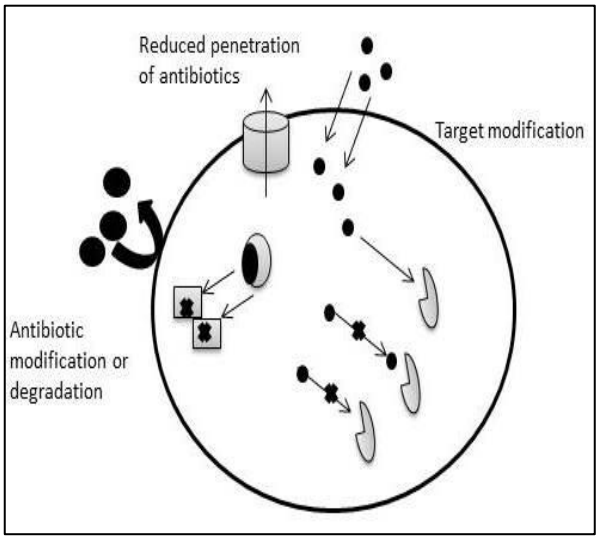

Figure 2: Mode of antibiotic resistance involving reduced penetration of antibiotics, degradation of antibiotics & modification of the target itself [4]

2. LITERATURE REVIEW

A research was conducted on the bacterial volatile organic compounds (VOCs) which were produced by the avocado rhizobacterium to suppress the common avocado pathogens [5-9]. It was concluded in the research that avocado rhizobacterium emits many antifungal compounds like ketones, pyrmycoides and various sulphur containing compounds that were involved in the suppression and have antifungal activities[10].

Another research was conducted to study the antifungal activity of films produced by the extract of Avocado and Citrus. These biodegradable antifungal films were developed to be used for controlling postharvest anthracnose pathogens [11-15]. It was concluded that the antifungal biodegradable films produced by the extracts of avocado and citrus incorporated with thymol and R-(-)-carvone can be used in limiting the diseases that occur in the fresh produce after the harvest [16].

3. DISCUSSION

Avocado (Persea americana) is a plant originating from the tropical new world. The fruit pulp has nearly 55% of oil, 6% of skin & nearly 3% of seed. The major suppliers of avocado oil are Chile, New Zealand etc. The lipid content of this oil, consisting mainly of monounsaturated fatty acids (MUFAs), has been associated with cardiovascular benefits along with anti-inflammatory efficacy. Based on these traditional usages, in this paper the antifungal role of the oil of avocado has been elucidated [17].

In Table 1, list of important breeds of avacado plant has been tabulated. In Table 2, the common fatty acids in the oil of avacado have been tabulated. In Table 3, the anti-oxidants isolated from avocado have been tabulated. In Table 4, the biological role of the oil of avocado has been tabulated. In Table 5, composition of Hass avocado has been tabulated. In Table 6, the mineral composition of Hass avocados has been tabulated. In Table 7, the Phytochemicals & Vitamins composition of Hass avocados has been tabulated. In Table 8, the lipids composition of Hass avacados has been tabulated [18].

Table 1: Important features and breeding history of avocado cultivars in this study

Name	Features & cultivation history
Anaheim	Origin is in Anaheim
Andes 3	From Chile
Andes 4	From Chile
Bacon	From Bueno park, USA
Daily 11	From Camarillo, USA
Duke 6	Rootstock descendent of Duke
Fuerte	From Mexico
Ganter	From Whittier
Hass	From La Habra heights
Reed	From Carlshud
Topa Topa	From Ojai

3.1. Constituents found in Avocado Oil

For a wholesome evaluation of the functional & nutritional features of avocado oil, the various parts and its variety has been tabulated below.

Table 2: List of the common fatty acids found in avocado oil

Variety	Estearic 18:0	Palmitic 16:0	Oleic 18:1 Ω7	Palmitolei c 16: 1 Ω7	α linolenic 18:3 Ω3	Linoleic 18:2 Ω6
HASS	0.5	17.26	61	9	1	11
	0.7	12.3	64	4	1.3	15
	0.54	18.26	63	8	0.7	11
	0.4	12.6	52	4	0.6	11
Australia	0.4	26	43	7	3	21
FORTUNE	0.5	11	74	3	0.9	10

Table 3: Antioxidants isolated from avocado oil. Concentration [=] mg/kg

Varieti es	α-Tocoph erol	ß-Sitoster ol	y-Tocoph erol	Campe sterol	Δ 5-avenast erol	Estigma sterol	Campes tanol	Sitoest anol
HASS	-	92	-	6.1	-	0.001	-	-
	-	95	-	5	-	0.14	-	-
	87	83	9	6	7	-	0.04	0.5
	-	-	-	5	-	0.001	-	0.6
FUERT E	-	92.9	-	6	-	-	-	-
	103	81	20	5	9	0.15	0.04	-

Table 4: Efficacy studies regarding the biological roles of avocado

Animal model	Protocol used	Conclusions
Male Wistar rats	Daily administration of avocado oil	Mimics losartan
Diabetic male rats	Daily administration of avocado oil	Improvement of mitochondrial function
Wistar rats	Daily feeding of avocado oil	Reduce insulin resistance
		Improvement of electron transport system
	Daily feeding of avocado oil & olive oil	Lowering of triglycerides

Table 5: Composition of Hass avocados

Nutrient	Value/100 g
Water (g)	72
Energy (kcal)	166
Energy (kcal)(insoluble fibre)	149
Protein (g)	2
Total fat (g)	15
Ash (g)	2
Carbohydrate (g)	9
Fibre (g)	7
Total sugars (g)	0.3
Starch (g)	0.1

Table 6: Mineral composition of Hass avocados

Minerals	Value per 100 g
Calcium (mg)	12.0
Iron (mg)	0.6
Magnesium (mg)	30
Phosphorus (mg)	55
Potassium (mg)	505
Sodium (mg)	7
Zinc (mg)	0.7
Copper (mg)	0.2
Manganese (mg)	0.2
Selenium (µg)	0.4

Table 7: Phytochemicals & Vitamins composition of Hass avocados

Phytochemicals & Vitamins	Value/100 g
Vitamin C (mg)	9
Thiamine (mg)	0.1
Riboflavin (mg)	0.1
Niacin (mg)	2
Pantothenic acid (mg)	1.5
Vitamin B6 (mg)	0.3
Folate food (µg)	90
Vitamin A (µg)	7
ß-Carotene (µg)	63
α-Carotene (µg)	24

Table 8: Lipids composition of Hass avocados

Lipids	Value/100 g
Total saturated fatty acids (g)	2
16:0 (g)	2.1
Total mono-saturated fatty acids (g)	10
18:1 (g)	9
Total polyunsaturated fatty acids (g)	2
18:2 (g)	2
18:3 (g)	0.13
Stigmasterol (mg)	2
Campesterol (mg)	5
ß-sitosterol	76
Cholesterol (mg)	0

Aliphatic acetogenins, are always isolated from avocado among which persenone A was reported to inhibit cyclooxygenase and role of nitric oxide synthase in a mouse macrophage cell line. Compound [(2 S ,4 S)-2,4-dihydroxyheptadec-16- enyl acetate] and [(2 S ,4 S)-2,4-dihydroxyheptadec- 16-ynyl acetate] showed inhibition of acetyl-CoA carboxylase.

A methanol extract of avocado fruits showed potent inhibitory activity against acetyl-CoA carboxylase, a key enzyme in fatty acid biosynthesis (acetyl-CoA carboxylase inhibitors are isolated from avocado fruit, and it is important in decrease in fatty acid synthesis, which is generally helpful in atherosclerosis). Recent studies have indicated the beneficial effects antioxidants in diet as a help in decreasing cellular damage by reactive oxygen species [19-23] .

Experiment design: Firstly, oil of avocado would be commercially procured & fungal species would be treated with various amounts of this oil for evaluating its efficacy.

Antifungal efficacy: The antifungal roles of the oil of avocado were evaluated against Candida albicans &Saccharomyces cerevisiae by using the disc diffusion assay[24].

Firstly, Mueller-Hinton agar media was prepared & poured onto the plates. Once the media in the plates got solidified, specific pure fungal lawn culture was established, following which sterile paper discs were soaked with this oil. Nearly 30 microliters of increasing amount of the oil &cyclohexamide (0, 1, 2.5, 5, 7.5 & 10 µl/ml) was used to separately soak each disc. Following incubation for 24 hours & at 37°Centrigrade, inhibition was observed by the measurement of the zone of inhibition's diameter. The experiments were repeated thrice[25].

The anti-fungal role of oil of avocado was evaluated on 2 fungal species. The oil of avocado (10 µl/ml) was found to be highly active against Candida albicans&Saccharomyces cerevisiae. The known antibiotic, Cyclohexamide (10 µg/ml) however showed excellent activity against all 2 fungal species (Figure 3). The results indicate that this oil can be researched further for its anti-fungal role[1]–[3].

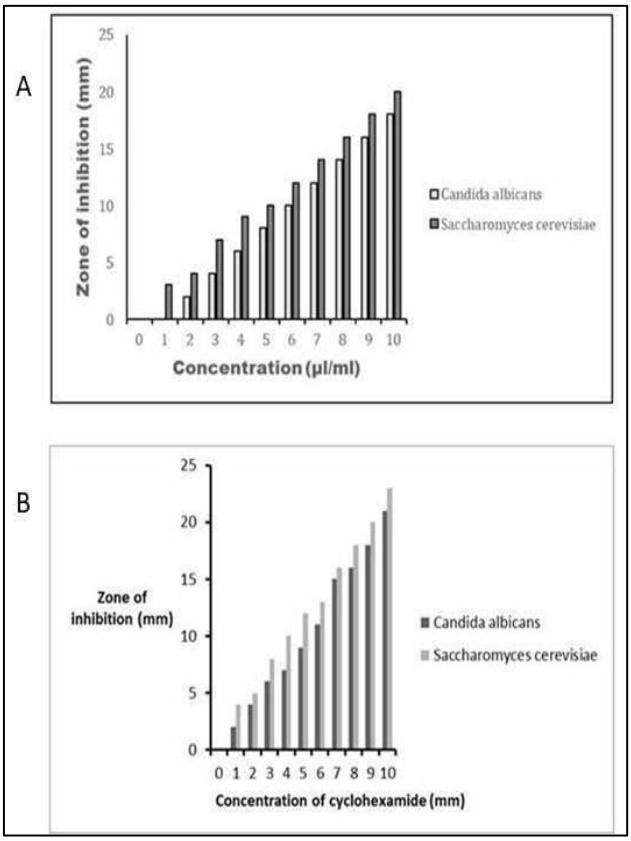

Figure 3: Graphical representation of the zone of inhibition induced in both Candida albicans & Saccharomyces cerevisiae, upon treatment with (A) increasing amount of the oil of avocadoafter 24 hours (B) increasing amount of cyclohexamide after 24 hours[10]

4. CONCLUSION

Natural products are being used towards pathogenic microbes since the discovery of penicillin. However, there has been increase in the frequency of microbes that are multi-antibiotic resistant which demonstrates that novel antibiotics are now much needed. Antibiotic resistance acts by changing the target of antibiotics, by increasing the efflux of antibiotic & by degrading the antibiotic itself. In this regard, this paper has attempted to evaluate the antimicrobial property of the oil of avocado.

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