



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VI **Month of publication:** June 2022

DOI: <https://doi.org/10.22214/ijraset.2022.43975>

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A Comparative Study of Antidiabetic Activity of *Azadirachta Indica*, *Aloe Vera* and *Allium Cepa*

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Abstract: Extract from medicinal plants are widely used to prevent various diseases due to the presence of lots of phytochemicals. The extracts from different parts like leaf, stem, fruit, flower, bark, root of *Azadirachta indica*, *Aloe vera* and *Allium cepa* show lots of pharmacological activity. Antidiabetic property is most important of them. Various parts of *Azadirachta indica*, *Aloe vera* and *Allium cepa* were largely used in Ayurveda, Unani and Siddha medicines. Chemical investigation on all three plants explores the presence of different types of active compounds like azadirachtin, nimbin, nimbidin, nimbidol, sodium nimbin, gedunin, salannin, and quercetin from *Azadirachta indica*, enzymes, minerals, sugars, lignin, saponins, salicylic acids, amino acids and vitamins like vitamins A (beta-carotene), C and E, vitamin B12, folic acid, and choline from *Aloe vera* and cyaniding glycosides, prostaglandins, quercetin, flavonoids, sterols, phenol compounds, catechol and protocatechuic acid from *Allium cepa*. This review explores the details of traditional use, phytochemicals and comparative studies of antioxidant and antidiabetic properties among lots of pharmacological properties of *Azadirachta indica*, *Aloe vera* and *Allium cepa*.

Keywords: *Azadirachta indica*, *Aloe vera*, *Allium cepa*, Antidiabetic property, Quercetin.

I. INTRODUCTION

Neem is a medicinal plant, and its leaves and other parts are used to exhibit immunomodulatory, anti-inflammatory, antihyperglycaemic, antiulcer, antimalarial, antifungal, antibacterial, antiviral, antioxidant, antimutagenic, and anticarcinogenic properties⁽¹⁾. Neem is a member of the mahogany family, Meliaceae, and its scientific name is *Azadirachta indica*⁽²⁾. Neem is mostly found in the Indian subcontinent and it is also found in dry areas of South Asia^(2, 3). The most important part of Neem is its leaf & bark, which is used in antioxidant and antidiabetic agents⁽⁴⁻⁷⁾. The fruit of Neem is used for the treatment of leprosy, diabetes, a disorder of the urinary tract and eyes, etc. The flowers of Neem are used for reducing bile, treating intestinal worms, etc⁽⁸⁾.



Figure: Neem tree and its different parts (leaves, bark, fruits, flowers)

Aloe vera is used as a topical gel to treat sunburn. It is mainly found in rocky areas and also found in the dry regions of Africa, Asia, Europe, America and India (Rajasthan, Andhra Pradesh, Gujarat, Maharashtra and Tamil Nadu)⁽⁹⁾. *Aloe vera* is a medicinal plant, which has antioxidant, antibacterial, antidiabetic, antiviral, antiseptic, etc. properties and it also helps in wound healing and skin disease⁽¹⁰⁻¹⁵⁾. It belongs to Asphodelaceae (Liliaceae) family, and is a shrubby or arborescent, perennial, xerophytic, succulent, pea-green colour plant and the botanical name of *Aloe vera* is *Aloe barbadensis miller*⁽⁹⁾.



Figure: Aloe vera and its leaves

Onion is a round vegetable with a brown skin that grows underground in the soil which used as medicinal prospect⁽¹⁶⁾. Onion is one of the important condiments widely used in all households all the year round⁽¹⁷⁾. The botanical name of onion is *Allium cepa* herbaceous biennial plant in the amaryllis family which is called *Amaryllidaceae* grown for its edible bulb⁽¹⁸⁾. The green leaves and immature and mature bulbs are eaten raw or used in preparation of vegetables⁽¹⁹⁾. Onions are used in soups, sauces and for seasoning foods⁽¹⁷⁾. Onion mainly used as antioxidant but it also shows antiinflammatory, antidiabetic, etc. activities⁽²⁰⁻²²⁾.



Figure: Onion tree and its parts

II. TAXONOMICAL CLASSIFICATION:

Taxonomical classification of *Azadirachta indica*, *Aloe vera* and *Allium cepa* are discussed in Table 1.

Plant Name	<i>Azadirachta indica</i> ^(23,24,25)	<i>Aloe vera</i> ^(26,27)	<i>Allium cepa</i> ^(28,29)
Kingdom	Plantae	Plantae	Plantae
Sub Kingdom	Tracheobionta	Tracheobionta	Tracheobionta
Class	Magnoliopsida	Liliopsida	Liliopsida
Sub Class	Rosidae	Lilidae	Lilidae
Order	Sapindales	Asparagales	Astaragales
Family	Meliaceae	Asphodelaceae	Amarymmidaceae
Subfamily	Melioideae	Asphodeloideae	Allioideae
Genus	Azadiracta	<i>Aloe</i>	Allium L.
Species	Azadiracta indica	<i>Aloe vera</i>	Allium cepa L.

Table 1: Taxonomical classification of *Azadirachta indica*, *Aloe vera* and *Allium cepa*

A. Bioactive Constituent

Bioactive constituent of *Azadirachta indica*, *Aloe vera* and *Allium cepa* are discuss in bellow mentioned table.

Azadirachta indica:(Table 2)

Plant Name	Source	Bioactive Constituents	Reference
<i>Azadirachta indica</i>	Seed Oil	Nimbidin	30
		Azadirachtin	
		Nimbin	
		Nimbolide	
		Gedunin	
		Mahmoodin	
	Bark	Gallic Acid and Catechin	
		Margolone, Margolonone and isomargolonone	
		Polysaccharides G1A, G1B	
		Polysaccharides G2A	
		NB-2 Peptidoglucon	
	Leaf	Cyclic Trisulphide and Cyclic tetrasulphide	
Polysaccharides			

Table 2: Bioactive constituent of *Azadirachta indica*

Aloe vera: (Table 3)

Plant Name	Bioactive Components	References
<i>Aloe vera</i>	Vitamins	31
	Enzymes	32,33,34
	Minerals	33
	Sugars	34,35
	Anthraquinones	32
	Sterols	31,33
	Amino acids	32
	Lignin	33
	Saponins	33

Table 3: Bioactive constituent of *Aloe vera*

Allium cepa: (Table 4)

Plant Name	Bioactive compounds	References
<i>Allium cepa</i>	Cyaniding glycosides, Prostaglandins, quercetin, other flavonoids, Sterols, Phenol compounds, Catechol, Protocatechuic acid are present in dry brown outer scale, diosgenin in flowers and bulbs	36
	Selenium	37
	Quercetin	38
	Flavenols	39
	S-alk(en)yl cysteine sulfoxides	40
	Flavonoids, allylsulfides	41,42
	Organosulfur compounds	43
	Thiosulfates	44
	Cycloallin	45,
	Fructose, quercetin-3-glucoside and isohamnetin-4- glucoside	46
	Sulfur and seleno compounds	47
	Sulfates, xylose, galactose, glucose and mannose	48,49

Table 4: Bioactive constituent of *Allium cepa*

B. Pharmacological Activity

Pharmacological activity of *Azadirachta indica*, *Aloe vera* and *Allium cepa* are discuss in bellow mentioned table.

Pharmacological Activity of *Azadirachta indica*: (Table 5)

Plant Name	Pharmacological Activity	Reference
<i>Azadirachta indica</i>	Antioxidant	50,51
	Free radical scavenging	52
	Wound healing	53,54
	Anti-inflammatory	55
	Anti-inflammatory	56
	Hepatoprotective	57,58
	Neuroprotective	59,60
	Immunomodulatory	61
	Antifertility	62
	Antifertility	63
	Reduction in plaque and gingival, Treatment of dental caries	64,65
	Antidiabetic	66-74
	Cardioprotective	67 75
	Antimicrobial	76
	Antimicrobial	77
	Antimicrobial	78
	Antitumor	79,80,81

Table 5: Pharmacological Activity of *Azadirachta indica*

Pharmacological activity of *Aloe vera*: (Table 6)

Plant Name	Pharmacological Activity	References
<i>Aloe vera</i>	Burn and wound healing property	82 - 87
	Moisturizing and anti-aging effect	88 - 95
	Immune System Restoration	96 - 98
	Anti inflammatory action	88, 93, 99 - 101
	Anti mutagenic effects	99, 102 - 108
	Effect on gastric acid secretion and Ulcers	93, 109
	Arthritis, Joint and Muscle Pain	88
	Antiseptic effect	88
	Anti-oxidant effects	110,93
	Immunomodulatory effects	111 -114, 93
	Anti bacterial/ anti fungal/ anti viral actions	105,115,116
	Antidiabetic Activity	117-122

Table 6 : Pharmacological Activity of *Aloe vera*

Pharmacological activity of *Allium cepa*: (Table 7)

Plant Name	Pharmacological Activity	References
<i>Allium cepa</i>	Antibiotic activity	123-127
	Antiviral activity	128, 129
	Antioxidant activity	130-134
	Anti-cancer activity	135-140
	Anti-inflammatory activity	141-143
	Antihyperlipidemic activity	144,145
	Anti-hypertensive activity	146, 147
	Anti-cancer activity	148-153
	Anti-arthritis activity	154
	Bronchodilator activity	155
	Anti-spasmodic activity	156-157
	Expectorant activity	158-160
	Antiseptic activity	161
	Anticoagulant activity	162-164
	Fibrinolytic activity	165-167
	Anti-helminthic activity	168
	Anti-platelet activity	169
	Anti-diabetic activity	170-180
	Anti-genotoxic and anti-mutagenic activity	181, 182
	Anti-pyretic activity	183-186
	Analgesic activity	187, 188
	Hepatoprotective activity Methanolic extract of onion	189, 190
Neuroprotective activity Methanolic extract of outer scales,	191	

Table 7: Pharmacological Activity of *Allium cepa*

C. Anti-diabetic activity of *Azadirachta indica*, *Aloe vera* and *Allium cepa*

1) *Azadirachta indica*

The hydroalcoholic extraction of neem, which produced anti-hyperglycemic activity in streptozotocin is used as the treatment of rats. In case, increase in glucose level absorption and glycogen deposition in isolated rat causes hemidiaphragm^(66,67). In spite of having anti-diabetic activity, it (neem) also shows anti-bacterial, antimalarial, antifertility, hepatoprotective and antioxidant effects⁽⁶⁸⁾. In Indonesia, neem is used as a traditional medicine from the ancient times. Diabetes mellitus is a significant metabolic disease which has many types of complication that's are; diabetic nephropathy, coronary heart disease, and hypertension. The chemical constituents of neem are as tannins, saponins, sterols, flavonoids, terpenoids, anthraquinones, and alkaloids which mainly used in the disease of diabetes. Rutin and quercetin of neem shows the activity of anti-hyperglycemic effects also^(69,70). The evaluated study of neem root bark (70% alcoholic) in diabetes, shows the result of that significantly in 800mg/kg dose⁽⁷¹⁾. The other experiment which was performed to test the pharmacological hypoglycemic action of *Neem* in diabetic rats, the result shows that the glucose tolerance test with neem extract is 250 mg/kg which indicated glucose levels were significantly less as compared to the control group and neem remarkably reduce the glucose level in the diabetic rat at 15 days⁽⁷²⁾. In in-vivo diabetic model, we studied *A. indica* & *B. spectabilis* chloroform, methanolic, and aqueous extracts were explored and the results showed that *A. indica* chloroform extract and *B. spectabilis* aqueous, methanolic extracts, which showed a good oral glucose tolerance and remarkably decreased the intestinal glucosidase activity⁽⁷³⁾. The other important study also suggested that leaves extract of neem and *Andrographis paniculata* (Kalmegh) also have significant antidiabetic activity and also helped in the treatment of diabetes mellitus⁽⁷⁴⁾

2) *Aloe vera*

Aloe vera is known as a popular houseplant to use as a folk medicine from ancient time. Plant contain two types of basic product one is gel mostly known as leaf pulp and another one is latex known as aloe juice. In both normal and diabetic rats extract of aloe gum increase glucose tolerance effectively⁽¹¹⁷⁾. Aloe leaves extract shows effect on blood glucose levels in normal and alloxan diabetic mice through stimulation of insulin synthesis or release of insulin from pancreatic beta cells⁽¹¹⁸⁾. This plant also helps to improve wound healing in diabetic mice and also shows an anti-inflammatory activity in dose dependent manner⁽¹¹⁹⁾. Alcoholic extract of *Aloe vera* gel shows hypoglycemic activity and helps to control glucose homeostasis by controlling the carbohydrate metabolizing enzymes. When aloe vera extract administered orally in different types of models like; normal rats, oral glucose-loaded rats and streptozotocin induced diabetic rats at a concentration of 200 and 300 mg/kg body weight shows significant results^(120,121). *Aloe vera* extract (10 µl/l) shows beneficial effects in treatment of type II diabetes by stimulated insulin secretion from the isolated islets of pancreas.⁽¹²²⁾

3) *Allium cepa*

The hypolipidemic and hypoglycemic activities of drinkable ripe onion juice product which name is "Black Onion Extract" the increasing dosage forms of onion aqueous extracts on alloxan- produced diabetic for likely used in the management of diabetes mellitus was explored⁽¹⁷⁰⁻¹⁷²⁾. The evaluation study of onion and garlic in experimentally produced diabetic rats by meta-analysis of related studies. National Center for Biotechnology Information database, the DBpia database, and the Korean studies Information Service System database conducted the ten systematic literature searches. We mostly studied the main three groups like; the normal group, the treated diabetic group, and the untreated diabetic group, it is compared for the various effect factors between two of the groups. Blood glucose concentration, body weight, and the concentrations of plasma total cholesterol, plasma triglycerides, plasma high-density lipoprotein-cholesterol, and liver glycogen are the effect factors⁽¹⁷³⁾. The natural product which has antidiabetic properties is *Allium cepa*, generally known as garden onion. In onion there is a phenolic content that is quercetin, which help in inhibition of liberation of D- glucose from oligosaccharides and disaccharides by inhibiting α-glucosidase, that may result delay absorption of glucose from intestine and it is considered the responsible for controlling blood glucose levels in the body. The fresh bulb which content ether extract, administered to pancreatectomized dogs and rabbits by gastric intubation⁽¹⁷⁴⁾. *Allium cepa* which have antidiabetic property is used for controlling type-II diabetes mellitus and it also used in our several life style diseases⁽¹⁷⁵⁾. Red onion which have hyperglycemic effects, is used for the treatment of Type I & Type II diabetic patients⁽¹⁷⁶⁾. Dietary bulbs of onion which have antidiabetic effect in high fat diet streptozotocin produced diabetes rodent model⁽¹⁷⁷⁻¹⁷⁹⁾. The potency of onion in Hypoglycaemic also showed the antioxidant activities⁽¹⁸⁰⁾.

III. CONCLUSION

Azadirachta indica, *Aloe vera* and *Allium cepa*; these three household plants can be used to control or treat diabetes. Different part extracts of all three plants are used as a medicine to treat the disease. All three types of plants are available all year round. *Azadirachta indica* contains tannins, saponins, sterols, flavonoids, terpenoids, anthraquinones, rutin and quercetin which shows anti-hyperglycemic effects and methanolic extracts of *Azadirachta indica* shows good oral glucose tolerance and remarkably decreased the intestinal glucosidase activity. *Allium cepa* extract, have hyperglycemic effects, used as a medicine for Type I & Type II diabetic patients and it also used in our several life style. *Allium cepa* extract contain quercetin a phenolic content is responsible for controlling blood glucose levels in the body by inhibiting liberation of D- glucose from oligosaccharides and disaccharides by inhibiting α -glucosidase. Aloe vera extract (10 μ l/l) stimulated insulin secretion from the isolated islets of pancreas and pancreatic beta cells which shows beneficial effect to reduce blood glucose levels and used to treat type II diabetes. Hypoglycemic activity shown in alcoholic extract of Aloe vera gel which helps to control glucose homeostasis by controlling the carbohydrate metabolizing enzymes. Among the all of three plants *Allium cepa* which is known as onion is highly acceptable in respect of *Azadirachta indica* (Neem), *Aloe vera* due to its bitter taste. But all of them are quite good for human.

CONFLICT OF INTEREST: Nil

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