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Review Article

A review on phytochemical screening and pharmacological activities of fruit of Indian mallow

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ABSTRACT

Abutilon indicum, a native traditional plant commonly known as Indian Mallow, is a versatile plant species that brings enormous amounts of medicinal uses from the history of traditional culture. This review emphasizes the current body of knowledge surrounding the effects of *Abutilon indicum*, highlighting its potential therapeutic application. The plant is well renowned for its diverse phytochemical composition, including alkaloids, flavonoids, and polysaccharides, which contribute to its wide-ranging biological activity. It has been discovered through research that Abutilon indicum extracts possess noteworthy pharmacological effects, including anti-oxidant, anti-inflammatory, anti-microbial, anti-diabetic, and hepatoprotective properties. In addition to its immunomodulatory effects, larvicidal, anti-convulsant, neuroprotective, and cognitive-enhancing capacities have gained attention in recent years and serve as natural alternatives to available allopathic medicine.
The focus of the review revolves around various noteworthy pharmacological effects of *Abutilon indicum*, including its anti-inflammatory, anti-microbial, anti-oxidant, and anti-convulsant properties. Furthermore, the examination of the plant extracts' phytochemical composition is also emphasized.
Those activities were discussed and reported with standard methods and compared with the available standard drugs. Overall, this comprehensive review provides valuable insights into the pharmacological effects of *Abutilon indicum*, underscoring its potential as a source of novel therapeutic agents and paving the way for future research and development.

1. Introduction

The genus *Abutilon L.* in the *Malvaceae* family includes approximately 150 annual or perennial herbs and shrubs, as well as subtropical countries in America, Africa, Asia, and Australia. It is one of the most famous plant species used in the treatment of many human diseases. The height is 3 meters. The indigenous peoples and tribes of India have been utilizing the entire plant or its distinct components, such as leaves, stems, roots, fruits, and seeds, for their medicinal properties for a considerable period of time. Traditionally, roots and bark are used as aphrodisiacs, anti-diabetics, nervine tonics, and diuretics. Seeds were used in urinary disorders. The seeds were used as a laxative in piles and in the treatment of coughs. Their leaves were generally taken orally in order to relieve body pain.[1–3]

2. Botanical Description

The leaves are ovate, pointed, and serrated, rarely lobed into three parts, and are 1.9–2.5 cm long. The flowers are yellow, and the stems are divided from the middle upwards. The

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petiole length is 3.8–7.5 cm. The stipule length is 9 mm. The stalks are often 2.5 to 5 mm long, isolated at the axilla, and joined at the top. Sepals 12.8 mm long, lobed in the middle, lobes ovate, tapering, corolla 2.5 cm in diameter, yellow, opening in the evening. The fruit is a capsule, densely hairy, and has a conspicuous, horizontally spread beak. The stems are strong, branched, 1-2 m high, and pubescent. The seeds are 3-5 mm in size, kidney-shaped, lumpy or slightly star-shaped, hairy, and black or dark brown.[4,5]

Synonyms: Rishyaprokta, Kankatika, Balika, Rishagadha, Bhuribala.[3]

Synonym(s): Sida indica L.[6]

2.1. Taxonomic status

1. Kingdom: Plantae
2. Subkingdom: Tracheobionta
3. Division: Magnoliophyta
4. Class: Magnoliopsida
5. Subclass: Dilleniidae
6. Order: Malvales
7. Family: *Malvaceae*
8. Genus: Abutilon
9. Species: Indicum[7]

3. Vernacular Names

1. Hindi: Jhampi, Kandhi, Kangahi, Kangai, Kanghani, Kanghi, Kanghi-ka-pat Country mallow
2. Sanskrit: Atibala, Bala, Balika, Balya, Bhuribala, Ghanta, Kankati, Kankatika, Mahabala, Pitapuspa, Shita, Shitapushpa, Vatyapushpika, Vikankata, Vrishyagandha,
3. Arabic: Deishar, Mashtul-gh-oul, Mashtulghola, Mashtulghou, and Mast-ul-ghoul
4. Kannada: Baralu kaddi, Giduthingi, Gidutingi, Haagade,Hettukisu,Tutti, Kisangigida Hetthukisu, Mudre Gida, Hetthutthi, Hettutti, Srimudre Gida, Srimudrigida, Tuttigida, Srimudre, Thurubee Gida, Thuthigida, and Shrimudrigida
5. Malayalam: Katturam, Katturan, Kuruntotti, Pettaka, Pettaka-putti, Pitikkapattu, Tutti, Tuvatti, Uram, Velluram
6. Marathi: Madmi, Petari, Pidari, Pitari, Akakai, Kangain, Kansuli, Karandi, and Mudra, Mudrika.Duddi, Nallatutti, Pamyarattutti, Paniyarattuti, Perun-tutti, Perundutti, Peruntutti, Thuththi, Ventutti
7. Telugu: Adavi benda, Adavibenda, Botiabenda, Botla benda, Doodi, Doodi chettu, Dudi, Erri benda, Erribenda, Kamalaku, Muttavashirubenda, Noogubenda, Nugu-benda, Thuthi, Thuthura benda, Thutirichettu, Thutthi, Thutthurubenda, Tutirichettu, Tutti, Tutturu-benda
8. Urdu: Kanghi[2]

Common Name: Abutilon, Indian mallow.[4]

Habitat: Present in sub-Himalayan tracts and hills up to 1,200 m and in hotter parts of India.

4. Phytochemistry of Abutilon Indicum

Knowledge of the individual chemical components of medicinal plants is essential to understand pharmacological activity and potential toxicity and to optimizing extraction processes.[1,8]

4.1. Leaves

Leaves contain tannins, mucilage, traces of asparagine, and organic acids, and leaf ash contains sulfates, chlorides, magnesium phosphate, and calcium carbonate. The ethanol extract contains 72% more quercetin than the flower. The leaves also contain alkaloids, sterols, triterpenoids, glycosides, essential oils, and various amino acids. Tocopherol and β-sitosterol are isolated from the leaves.

Abutilon indicum leaf extract has a high alcohol content due to the combined synergistic action of the flavonoids luteolin, chrysoeriol, luteolin-7-o-beta-glucopyranoside, chryceriol-7-o-beta-glucopyranoside, and quercetin-3, which prevents oxidative stress and liver damage. o-β-glucopyranoside.[1,8]

Eudesmic acid, ferulic acid, and caffeic acid were isolated from the methanol extract of the leaves of the plant *Abutilon indicum.* IR, 1H-NMR, 13C-NMR, mass spectrometry, and chemical techniques enabled the identification of these compounds. Aldehydes, hydrocarbons, fatty acids, and esters were detected for the first time in the ethanolic leaf extract of *Abutilon indicum* using gas chromatography combined with mass spectrometry.[6]

4.2. Root

Root contains asparagin. In 1989, gallic acid and fixed oil were reported from roots. The presence of β-amyrin and different fatty acids in the roots of *Abutilon indicum* was reported in 1984. Galactose and galacturonic acids are present in the mucilage fraction. The presence of sterols, terpenoids, terpenes, flavonoids, and steroids are reported. In 2009, the phyto-constituents from the root, which are non-drying oils, consist of different fatty acids like linolic, oleic, stearic, palmitic, lauric, myristic, caprylic, capric, and unusual fatty acids with a C17 carbon skeleton, which are unsaponifiable.[6]

Recently, in 2013, beta-sitosterol and amyrin from root extracts were identified.[9]

4.3. Fruits

Fruits contain flavonoids and alkaloids. In 2016, it was shown that the compounds 2-pentanone and 4-hydroxy-4-

methyl seem to be the most stable compounds. Benzene 1,3-dimethyl (m-xylene), p-xylene, and o-xylene were identified at retention time 6.44 with the highest probability. Three compounds—c-sitosterol, a-sitosterol, and cholest-5-en-3-ol, 4,4-dimethyl were identified.[9]

4.4. Flower

The occurrence of gossypetin-7- and 8-glucosides and cyanidin-3-rutinosides in *Abutilon indicum* was identified. Two sesquiterpene lactones, i.e., alantolatone and isoalantolatone, have been reported for the first time. Seven flavonoid compounds are luteolin, chrysoeriol, luteolin-7-O-beta-glucopyranoside, chrysoeriol-7-O-beta-glucopyranoside, apigenin-7-O-beta-glucopyranoside, and quercetin-3-O-beta-glucopyranoside. quercetin-3-O-alpha-rhamnopyranosyl (1,6)-beta-glucopyranoside was isolated and identified from the flowers of Abutilon indicum. Oil obtained from the flowering tops yielded geraniol, geraniol actate, α-pinene, borneol, and tetradecane.[1,9,10]

4.5. Seed

Acid-catalyzed fragmentation, periodate oxidation, and methylation showed that the seed gum has a branched structure consisting of linear chain β-D^{1,4} linked mannopyranosyl units, the sum of which is substituted at ortho-6 by two α-D,^{1,6} galactopyranosyl units that are mutually linked glycosidically as end groups. Chemical analysis of the seed oil showed the presence of steric, linolenic, oleic, and palmitic acids. Seeds were analyzed for crude pentosan, protein, and water-soluble mucilage content. HBr reactive fatty acids, viz., 12,13-epoxyoleic (vernolic acid) and 9,10-methylene-heptadec-8-enoic (malvalic acid), were identified in the seed oil. The amino acid profile of seed protein (31%) contains glycine, serine, glutamine, lysine, threonine, methionine, isoleucine, proline, alanine, cysteine, phenylalanine,leucine, asparagin, histidine, valine, and argininine. TLC-GLC studies of seed oil revealed the presence of a high amount of unsaturated acids. The essential oil of the plant contains β-pinene, caryophyllene, caryophyllene oxide, 1,8-cineole, ceraneol, ceranyl acetate, eudesmol, and farnesol. Steric acid[10] and palmitic acid[11] were the principal components of the saturated acids. Raffinose was obtained as a prime sugar component found in seeds.[1,6,8]

4.6. Stem

20,23-dimethylcholesta-6,22-dien-3β-ol was successfully extracted from the strain.[9]

Aerial part: The above-ground part of the system leads to the separation of n-alkane mixtures,

Whole Plant: In 1982, they isolated various chemical components from *Abutilon indicum*. These include farnesol, borneol, β-pinene, eudesmol, geraniol, β-caryophyllene, and their derivatives. In 1990, taraxasterol, lupeol, sitosterol, and their acetyl derivatives were isolated. In 1972, several flavonoids were isolated, including quercetin, kaempferol, gossypetin, and cyanide 3-glucoside. As a result of investigating the overall chemical composition, out of a total of 28 known compounds, two of them are abutilon A and (R)-N-(1'-methoxycarbonyl-2'-phenylethyl)-4-hydroxybenzamide. facility. Sitosterol is a promising new mosquito repellent. Insecticidal substances were discovered in petroleum ether extracts. No tannins were present in the 50% ethanol extract of the plant. Plant essential oils include caryophyllene oxide, 1,8-cineole, ceraneol, elemene, and ceranyl acetate. Preliminary phytochemical tests indicate the presence of glycosides, leucoanthocyanidins, saponin alkaloids, cardiac glycosides, cyanogenic tannins, and phenolic compounds in leaves, roots, and stems. The plant was found to contain gum resin and mucilage.[8,12–18]

5. Phytochemical Screening

5.1. Test for alkaloids

Add dilute hydrochloric acid to the extract and filter. The filtrate is treated with various alkaloid reagents.

5.2. Mayer test

Treat the filtrate with Mayer's reagent. The appearance of the cream color indicates the presence of alkaloids.

5.3. Dragendroff test

Treat the filtrate with Dragendroff reagent. The appearance of a reddish-brown precipitate indicates the presence of alkaloids.

5.4. Hager test

When the filtrate is treated with Hager's reagent, the appearance of a yellow precipitate indicates the presence of alkaloids. This test confirms the presence of alkaloids in the leaves, aerial parts, and whole plants.[19]

5.5. Test for carbohydrates

The small quantities of filtrate will be dissolved in 4 ml of distilled water and filtered. The filtrate will be subjected to

5.6. Molisch's test

A small portion of the filtrate will be treated with Molisch's reagent and sulfuric acid. The formation of a violet ring indicates the presence of carbohydrates. [7.12]

5.7. Barfoed test

To the 2 ml of extract, 1 ml of Barfoed's reagent was added and boiled in a water bath for a few minutes. The formation of a reddish-brown precipitate indicates the presence of carbohydrates.[7]

6. Protein Tests

6.1. Biuret test

Treat the extract with a copper sulfate solution, and then add a sodium hydroxide solution. The appearance of a purple color indicates the presence of protein.

6.2. Miron test

Treat the extract with Miron reagent. The appearance of a pink color indicates the presence of protein.[11]

This test confirms the presence of protein in seed oil.

6.3. Testing for phenolic compounds

1. (a) Treat the extract with a neutral iron chloride solution. The appearance of a purple color indicates the presence of phenolic compounds.
   (b) Treat the extract with a 10% sodium chloride solution. The off-white appearance suggested the presence of phenolic compounds.

6.4. Testing for flavonoids

1. (a)) Hydrolyze 5 ml of the extract with 10% sulfuric acid and cool. Then it is extracted with diethyl ether and divided into three parts in three separate test tubes. Add 1 ml of dilute sodium carbonate, 1 ml of 0.1N sodium hydroxide, and 1 ml of strong ammonia solution to the first, second, and third test tubes, respectively. The yellow-colored development of in each test tube indicated the presence of flavonoid.[11]
   (b)) Shinoda TestThe extract is dissolved in alcohol, and the magnesium particles are bubbled. Concentrated hydrochloric acid is added dropwise and heated, and the appearance of magenta color indicates the presence of flavonoids.This test confirms the presence of flavonoids in roots and fruits.

6.5. Tests for cardiac glycosides

(a) Keller-Killiani test use 0.5 g of extract diluted to 5 ml with water, 2 ml of glacial acetic acid and 1 drop of ferric chloride solution were added. This was readministered with 1 ml of concentrated sulfuric acid. A brown ring at the interface indicated the presence of a deoxysugar characteristic of cardenolides. While a greenish ring may grow in the acetic acid layer just above the brown ring and progressively expand across this layer, a violet ring may appear below the brown ring.

This test confirms the presence of cardiac glycosides in the leaf, root and stem.

6.6. Testing of saponin

1. (a)) Foam test Approximately 1 ml of the extract was diluted to 20 ml with distilled water and shaken well in a test tube. The formation of bubbles at the top of the test tube indicates the presence of saponin.
   (b)) Foam test 5 ml of distilled water was added to 1 ml of extract and shaken vigorously. Forth formation indicates the presence of saponins. This test confirms the presence of saponins in the aboveground parts.

AIFM - Mother extract of A. indicum fruit; AIFP - Petroleum ether fraction of A. indicum fruit. AIFC - Chloroform fraction of A. indicum fruit; AIFE - Ethyl acetate fraction of A. indicum fruit. AIFB - Butanol fraction of A. indicum fruit; AIFA - Aqueous fraction of A. indicum fruit

7. Pharmacological Activities of *Abutilon Indicum*

Abutilon indicum is a native traditional plant that belongs to tropical and subtropical regions and possesses various medicinal and pharmacological activities. It possesses various medicinal and pharmacological activities and helps in treating various ailments. Being a shrub, it was most widely used by the ancient people, especially Tamils, to treat various diseases. It was also used in various traditional medicines, including Siddha and Ayurveda. Existing as a medicinal plant, *A. indicum* offers each and every part of the plant to the medicinal industry to treat health conditions. The parts include leaves, roots, flowers, stems, seeds, fruit, etc. Let's explore the pharmacological activities of those advantageous boons of nature.

8. Anti-Inflammatory Actions

While focusing on the pharmacological effects of *A. indicum*, each part possesses a separate activity. But the whole plant possesses anti-inflammatory and immune-stimulating activity. Hence, the anti-inflammatory effect serves as one of the most important activities of the plant, due to its enormous abundance. One study found that the presence of flavonoids in *A. indicum* accounts for the anti-inflammatory effect. Various studies were conducted in order to evaluate and identify the anti-inflammatory activity of A. indicum. To analyze the anti-inflammatory effects, some methods are used, including the carrageenan-induced paw edema method and formalin-induced hind paw edema.

Table 1: *Phytochemical* analysis of various fractions of *A. Indicum*

	AIFM	AIFP	AIFC	AIFE	AIFB	AIFA
Alkaloids	-	-	-	-	-	-
Carbohydrates	++	++	++	+	++	++
Proteins	++	-	+	+	++	-
Phenols	++	+	++	++	+	+
Flavonoids	++	+	+	++	+	+
Glycosides	-	-	-	-	-	-
Saponins	+	-	-	+	+	+

+Present, -Absent

Various doses of aqueous and ethanolic extracts of *A. indicum* were given to different groups of rats. In the mechanism of inflammation, the edema and inflammation due to carrageenan and formalin are biphasic. In carrageenan, the first phase is mediated through histamine, kinin, and serotonin. In the second phase, it is due to prostaglandins and slow-reacting substances. Formalin-induced inflammation is also a biphasic response. With these inflammations, the ethanolic extract has better anti-inflammatory results.

Anti-inflammatory activity was also evaluated by performing the HRBC [Human Red Blood Cell] stabilization technique (assay). By comparing the results, it has been shown that their activities are more potent as compared to diclofenac sodium. But its effects decrease with an increase in time. The anti-inflammatory effect may be due to either inhibition of lysosomal enzymes or stabilizing the lysosomal membrane.

9. Anti-Convulsant Actions

A convulsion is a state of rapid and involuntary muscle contraction that may lead to uncontrollable shaking and involuntary limb movement.

Convulsion is the part of epileptic seizures that may be due to improper and imbalanced activity of the brain. There are several factors that can contribute to this condition, such as infections, trauma, stroke, tumors, injury, and even genetic predisposition. Epilepsy may be classified primarily into two types: partial and generalized, which are based on the onset of seizures.

Various allopathic medications were available to treat those convulsions, which provided greater protection along with their own side effects.

In order to make an alternative for those drugs, drugs from plant materials are extracted and made into formulations with reduced or no side effects. A. indica is one such type of drug. The various extracts of the plant (*A. indicum*) were extracted. The most commonly used extraction methods are ethanolic and aqueous extracts, which contain most of the primary metabolites of the plant.

The anti-convulsant activity of A. indica is investigated by the PTZ (pentylene tetrazole) and MES (maximum electroshock)-induced convulsion methods using Wister rats.

Administering *A. indicum* ethanolic extract (AIE) at a dosage of 400 mg/kg following PTZ and MES-induced convulsions led to a 67% survival rate among the animals after 24 hours of treatment. While in A. indica aqueous (AIA), 400 mg/kg results in 34% of the animal survival rate, AIA and AIE showed anti-convulsant activity. The observed activity is due to increasing the onset of clonic extension and decreasing the tonic time of extension. Finally, this shows that *A. indicum* possesses potent anti-convulsant activity. The presence of linoleic acid, or flavonoid compounds, is one of the phytoconstituents that seems to indicate anti-convulsant activity.

10. Anti-Oxidant/Free Radical Scavenging Action

Oxidation is one of the normal and essential reactions that take place in our body. Whereas oxidative stress is due to the imbalance between antioxidants and free radicals in the body, a well-balanced free radical helps our body fight against pathogens, but when the free radicals become more concentrated compared to the antioxidants, they begin to damage the various types of cells and tissues, which may lead to a vast number of health issues, including neurodegenerative disease, metabolic disease such as diabetes, cardiac-related issues such as atherosclerosis, hypertension, etc., which are considered life-threatening diseases. To prevent such disease, a proper balance must be maintained between the anti-oxidants and reactive species (free radicals) in our system. This could be achieved either by lowering the free radicals or by increasing the antioxidants in our body.

Various supplements were available to increase free radical scavenging activity along with antioxidant activity. But the best way to obtain it is through a naturally occurring source, to enhance reliability and safety. One such source is *A. indica.* At first, the extracts of the plant from various parts are collected using various solvents. And those extractions were evaluated for their TAC (total antioxidant capacity), total phenolic content, total flavonoid content, and Trolox equivalent antioxidant capacity (TEAC). They were found and subjected to various methods of analysis,

including the ABTS decolorization assay, DPPH free radical scavenging activity, FRAP assay, and linoleic acid emulsion system. Also, various statistical analysis methods were performed in order to obtain the relationship between different phytoconstituents and the total antioxidant activity of the plant.

From the above assays, it is clear that the extraction of the active phytoconstituents establishing anti-oxidant properties was efficient, and it was found that the aerial part of the plant contains a higher content of the required active constituent when compared to other parts of the plant. From the ABTS assay, they found that TEAC values ranged for the n-hexane and butanol fractions from 3.09 to 10.5 μm. Then the FRAP assay shows the reducing power of the fractions in the order of butanol > ethyl acetate > chloroform > hexane > ethyl acetate.

The DPPH radical assay found the EC50 and TEC50 values of the extract *A. indicum*. From the all-over assay and evaluation, it was found that the free radical scavenging activity or antioxidant property of the *A. indicum* extract is dose-dependent and possesses potent antioxidant properties.

11. Anti-Microbial Activity

In today's situation, microbial infection serves as a significant health challenge. Those infections were usually caused by pathogens such as viruses, bacteria, fungi, parasites, and so on. which may lead to a wide range of diseases that are affecting humans as well as other living sources such as plants and animals. In this modern interconnected society, it is important to understand, manage, and develop advanced medical treatment from various resources. One of such sources is a natural resource, especially a plant source. Various plant extracts were available that were used to treat the microbial infection. *A. indicum* is the plant that has various pharmacological activities; among those activities, anti-microbial activity serves as the most important action, which includes antibacterial, anti-fungal, and also anti-viral activity.

12. Anti-Bacterial Activity

The antibacterial activity of *A. indica* was investigated against microbial strains such as Escherichia coli and Streptococcus pyogens. Those species were chosen, and the disc diffusion method was followed. The plant extracts were prepared using ethanol and water as ethanolic and aqueous extracts. The study was conducted, and as per the results, the antibacterial effect of the plant extract increases with increasing concentration. The observed results were compared to the standard drug chloramphenicol, and it revealed that Streptococcus pyogens were more sensitive when compared to *E. coli.*

And another study was conducted against *Bacillus subtilis, Staphylococcus aureus, Klebsiella pneumonia, Pseudomonas aeruginosa, E. coli, and Salmonella typhi.* The ariel part of the plant was extracted using chloroform, ethanol, and water. The experiment was conducted in Muller-Hington agar medium, and the results were based on the zone of inhibition. From the study, it was observed that the ethanolic leaf extract of *A. iariel* was found to be highly active against *Staphylococcus aureus, Pseudomonas aeruginosa, E. coli, and Salmonella* typhi**.** And the chloroform extract shows moderate activity against all organisms except Klebsiella pneumonia. Whereas aqueous extract possesses no activity against any organisms.

From the above studies, it has been identified that *A. indicum* possesses the most effective antibacterial activity.

13. Anti-Fungal Activity

The anti-fungal or anti-mycotic activity of the plant *A. indica* was studied under the disc diffusion method against the fungal species Aspergillus niger and Candida albicans using both ethanolic and aqueous extracts of the leaves of *A. indica.* The results observed were compared to the standard drug fluconazole. The observation showed that the ethanolic extract provides more sensitivity towards *A. niger* when compared to *Candida albicans.*

At the same time, when compared to another standard drug, Itraconazole, the leaf extract against *A. niger* and *Candida parapsilosis*, it was observed that the sensitivity is more towards *C. parapsilosis.* On the basis of the zone of inhibition

And from one of the previous studies conducted on the chemical investigation of the methanolic extract of Anda leaves, it was identified that the compounds eudesmic acid, ferulic acid, and caffeine acid were in the methanolic extract. The compounds obtained on analysis possess both anti-fungal and anti-bacterial activity against a variety of microbes. The chief compound that provides an antimicrobial spectrum is quercetin (a flavonoid compound).

14. Anti-Viral Activity

Similar to its antibacterial and antifungal activity, *A. indicum* also exhibits anti-viral activity. The methanolic extract of the aerial part of the plant exposes potent anti-viral activity against Influenza virus and Sindbis virus, which is the surrogate for Hepatitis B virus.

15. Conclusion

Abutilon indicum presents itself as a valuable resource for the development of novel therapeutic agents. The traditional use of the plant in various cultures is also supported by modern scientific research that validates the historical significance of the plant, although it is necessary to conduct further investigation to establish its efficacy and safety profiles in clinical settings. Further exploration of this

plant's potential may lead to the development of innovative pharmaceuticals with wide therapeutic applications.

16. Source of Funding

None.

17. Conflict of Interest

None.

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