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Ethnomedical profile of different parts of *Coccinia cordifolia*: A review

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Abstract
Coccinia cordifolia, belonging to the Family Cucurbitaceae, has been used as a traditional medicine as a household therapy for many diseases. It is one of the medicinal herbs in the traditional practice of Bangladesh as well as Indian medicine. *Coccina cordifolia* is a dioecious, perennial and herbaceous climber with glabrous stems and tuberous roots. The existence of secondary metabolites such as alkaloids, flavonoids, saponins, glycosides etc. in the plant may contribute to their medicinal value. The different parts of *Coccinia cordifolia* have many pharmacological activities like antimicrobial, anti-inflammatory, antidiabetic, analgesic, antipyretic, antiulcer, antioxidant, hepatoprotective, hypoglycemic, antimalarial, anticancer, antitussive, mutagenic, antidyslipidemic etc. The present study gives pool information about the botany, phytochemical constituents and pharmacological actions of different parts of *Coccinia cordifolia*.

Keywords: *Coccinia cordifolia,* phytochemical constituents, pharmacological activity

1. Introduction
Traditional medicines or folk medicines encompass medical knowledge of ancient time that rise over generations before of the era of modern medicine. Ayurveda, Siddha and Unani are indigenous system of medicine that still exists and some of their medicines are already available in market [1]. In aspect of Bangladesh, about 70-80% people rely on indigenous system to maintain their health problems [2]. *Coccinia cordifolia* is a climbing herb belongs to the family of Cucurbitacae.This plant is commonly known as "ivy gourd" which is available in wild form and is native of Asia and Central Africa, and distributed in Australia, China, India, Bangladesh, Tropical Asia and Africa. It is one of the medicinal herbs in the traditional practice of Bangladesh as well as Indian medicine[3].The fruits of *Coccinia grandis* is utilized as (a) vegetable when green and eaten new when matured into brilliant red shading. All aspects of this plant is profitable in medicine and different preparations have been specified in indigenous arrangement of prescription for different skin ailments, bronchial catarrh, bronchitis and Unani frameworks of drug for ringworm, psoriasis, little pox, scabies and other bothersome skin emissions and ulcers. The whole plant of *C. cordifolia* possesses diversified pharmacological activities like analgesic, antipyretic, anti-inflammatory, antimicrobial, antiulcer, antidiabetic, antioxidant, hypoglycemic, hepatoprotective, antimalarial, antidyslipidemic, anticancer, antitussive, mutagenic activities. It is also evident that the ethanolic leaf extract of *Coccinia cordifolia* has strong effect against bacterial strains compared to its root [1]. It is used for decoction gonorrhoeae, diabetes, pyelitis, cystitis, strangury, snake bite, urinary gravel and calculi.

1.1 Vernacular Names
Bangla: Telakucha, Kuchla;
English: Ivy gourd.
Marathi: Tindora (Tindori, Tindora);
Oriya: Parwal, Kundru, Tondi;
Malayalam: Tendli (Konkani), Ghiloda, Kundri, Kowai, Kovai, Kovakkai.

1.2 Botanical Description of *Coccinia cordifolia*
C. cordifolia is a dioecious, perennial and herbaceous climber with glabrous stems and tuberous roots. This plant possesses axillary tendrils long-lived scrambling or climbing vine grows up to 13 m in height and can form a very dense cover over vegetation. It usually covers trees, understory vegetation, fences, power poles, and other human-made structures in residential neighborhoods and agricultural areas. When stems of *C. cordifolia* touch soil, they strike roots readily at the nodes [4].Initially, younger stems are slender, green, and smooth but as they grow they become swollen and semi-succulent in nature. Leaves are alternate and simple. The alternately arranged leaves are borne on stalks 1-3 cm long and coiled tendrils are often produced in their forks. These lobed leaves are somewhat ivy-shaped in nature (3.5-9 cm long and 4-9 cm wide) and usually have tiny teeth spaced along their margins. The tendrils are long, elastic with coil-like springy character that can wrap around the host to the entire length. This species produces separate male and female flowers on separate plants. These white, tubular, flowers are borne singly in the leaf forks on stalks 1-5 cm long. They have five small narrow sepals (6-8 mm long) that are joined together at the base and usually have five spreading petal

lobes with pointed tips. In the short tube at the center of the male flowers are three convoluted stamens, while the center of the female flowers usually bears three hairy stigmas. The ivy gourd fruit belongs to the berry type: oval and hairless with thick and sticky skin. The raw fruit is green in color resembles a small dark green cucumber with paler stripes. These fleshy fruit (2.5-6 cm long and up to 3.5 cm wide) turn bright scarlet red as they mature and contains several pale, flattened seeds. Two varieties of *C. cordifolia* are recognized; tender fruits are bitter in one variety and not bitter in other, and the latter is used in Asian cooking [5, 6, 7]. Morphologically no difference is evident between them, however; both varieties are invasive and are found to grow close to each other.

1.3 Botanical Classification

Kingdom: Plantae
Order: Cucurbitales
Family: Cucurbitaceae
Subfamily: Cucurbitoideae
Tribe: Benincaseae
Sub tribe: Benincasinae
Genus: *Coccinia*
Species: *Coccinia cordifolia*

Fig 1: *Coccinia cordifolia*

2. Phytochemical Constituents

C. cordifolia contains large amount of beta-carotene and also rich in complex carbohydrates, fiber, and a vast array of vitamins B and minerals. It is also a valuable source of nutrients. Several phytochemical constituents of great importance are reported from different parts of the *C. cordifolia* plants.

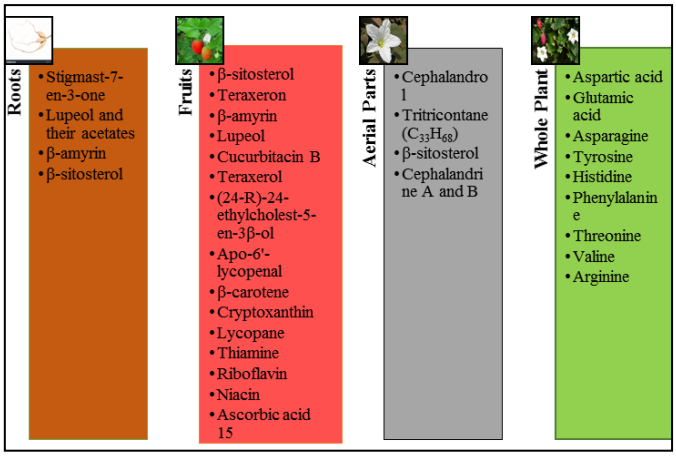
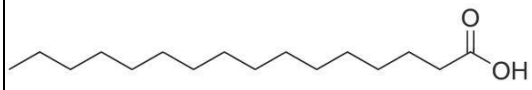
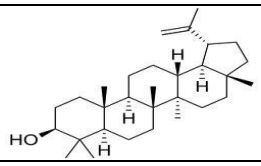
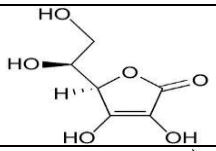
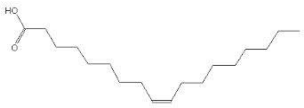
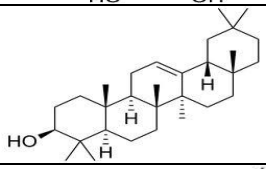
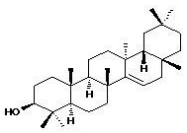
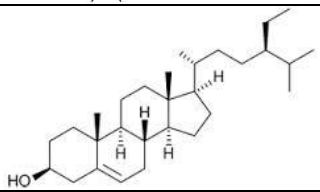
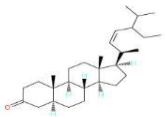
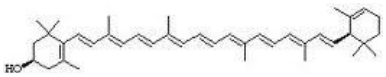
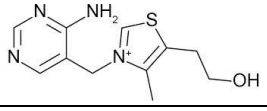
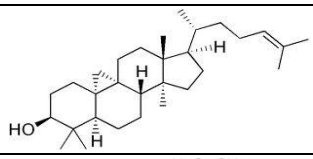
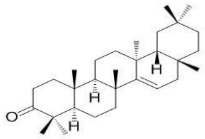
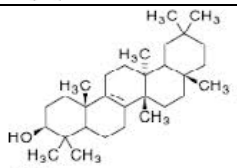
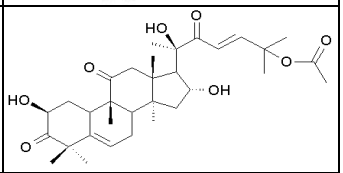
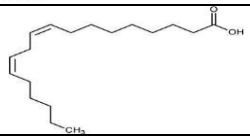


Fig 2: Chemical Constituents present in various parts of *Coccinia cordifolia* [8, 9, 10, 11]

The aqueous extract of fresh leaves of ivy gourd exhibited anthraquinons in addition to alkaloids, carbohydrates, proteins and amino acids, tannin, saponins, flavonoids, phytosterol, triterpenes. Cephalandrol A and cephalandrol B, sigma-7-en-3-one, taraxerone and taraxerol [12]. Phytochemical screening of *C. cordifolia* reported the presence of saponin, cardenoloids, flavonoids and poly phenols which may be attributed to antibacterial activity. Phenolic compounds are generally noted for their antimicrobial activities. The fruits of *C. cordifolia* are known to contain active constituents like taraxerone, taxerol, amyran, lupeol and glycoside cucurbitacin B. The leaves are bitter sweet and astringent. Major phytoconstituents present in *C. cordifolia* are cardenolides, saponins, flavonoids and polyphenols [9]. Seed fat mainly contains palmitic (16.3%), oleic (22.4%) and linoleic (58.6%) acids. Plant also contains arabinogalactan, xyloglucan and xylan [8]. Petroleum ether, chloroform, methanolic and aqueous extract of the leaves was tested for phytochemical analysis. The study showed that petroleum ether extract contains sterol compound and tannins, proteins and amino acid as well as glycosides were present in chloroform extract. In addition, tannins, flavonoids, glycosides, phenols, carbohydrates, proteins and amino acid, saponins and alkaloids were found in ethanolic extract whereas aqueous extract showed positive result for proteins and amino acid, glycosides, phenols, flavonoids, carbohydrates and alkaloids [10]. Methanolic extracts of the plant also revealed the presence of alkaloids, steroids, tannins, saponins, ellagic acid, phenols, glycosides, triterpenoid and flavonoids [11].

Table 1: Major phytochemical compounds present in *Coccinia cordifolia* [9, 10, 11]

Name of the constituents	Structure	Name of the constituents	Structure
Palmitic acid		Lupeol	
Ascorbic acid		Oleic acid	
Beta-amyrin		Taraxerol	
Beta-sitosterol		Stimast-7-en-3-one	
Cryptoxanthin		Thiamine	
Cycloartenol		Taraxerone	
Isomultiflorenol		Cucurbitacin B	
Lenoleic acid			

3. Reported Pharmacological Properties of *Coccinia cordifolia* [13-56]

3.1 Anti-Diabetic Activity

Hypoglycemic effect has been observed in patients treated with homogenized freeze dried leaves of *Coccinia indica* [13]. Ethanol extract (250mg/kg) of whole plant of *Coccinia indica* reduce the blood glucose level in fasted, glucose fed and diabetic albino rats [14]. Blood glucose reducing effect of alcoholic extract (250mg/kg, orally) of *Coccinia indica* was observed in fasted and glucose fed hyperglycemic male albino rats [15]. Alcoholic leaf extract of *Coccinia indica* produced hypoglycemic effect in normal fed and 48 hours fasted rats and response was mediated by suppression of gluconeogenic enzyme glucose-6-phosphatase [16]. Pectin (200mg/100gm/day) which was isolated from the fruits of *Coccinia indica* exhibited hypoglycemic effect and also increase the glycogen content of liver in normal rats [17]. The blood sugar level of diabetic rats was lowered by applying ethanol (60%) leaf extract (200mg/kg, orally) through depression of fructose-1-6-biphosphatase, glucose-6-phosphatase and increased glucose oxidation by activation of glucose-6-phosphate dehydrogenase [18]. Leaf extract of *Coccinia indica* produced hypoglycemic and insulin secretogouge activity in diabetic patients [19]. Dried extract of *Coccinia indica* (500mg/kg, p.o. for 6 weeks), showed hypoglycemic activity in diabetic patients. Extract shows insulin like activity and improved the activity of enzymes in lypolytic pathway and glycolytic pathway [20]. Raw *Coccinia grandis* leaves lowered the postprandial blood sugar levels proving the herb improving the glucose tolerance [21]. Diabetic rats treated with C*occinia indica* alone and in combination with low dose of acarbose produced significant decrease in the blood glucose level after 7 weeks of treatment [22]. The root, fruit, leaf and aerial part extracts of *Coccinia grandis* have a

hypoglycaemic effect on alloxan induced diabetes in mice [23].

3.2 Antimicrobial Activity

The aqueous extracts of seeds of *Coccinia indica* did not show much significant activity, while the organic extracts (petroleum ether and methanol) showed the highest activity against s*taphylococcus aureus* [24]. *In vitro* antibacterial activity of leaves and stem extracts of *Coccinia grandis* L. has been investigated against *Corynebacterium diptheriae, Bacillus cereus, Streptococcus pyogenes, Staphylococcus aureus, Escherichia coli* (ETEC), *Proteus mirabilis, Klebsiella pneumonia, Salmonella typhi, Pseudomonas aeruginosa* and *Shigellaboydii*. Water extract of leaves and ethanolic extract of stem showed significant activity against *Shigellaboydi* and *Pseudomonas aeruginosa* respectively [25].The chloroform extract of *Coccinia cordifolia* showed antibacterial activity with the average zone of inhibition 9-12mm against gram positive bacteria *Sarcinalutea* and *Bacillus subtilis* [26]. Ethanol leaf extract of *C.grandis* showed high antibacterial activity against *S.aureus, B.cereus, E.coli, K. pneumoniae* and *S.pyogens* with an inhibitory concentration below 31.5µg/ml [27]. The antibacterial activity of *C. grandis* leaf was evaluated against the gram positive strains such as *St. aureus, B. substillu s*and in gram negative strains such as *E. coli* extract using solvents such as ethanol, ethyl acetate. Ethanol stem extract showed the highest activity against both against gram positive and gram negative organism's bacterial strains [28]. Both cold and hot ethanol and acetone extracts of *C. grandis* fruits showed some degree of bacterial growth inhibition where acetone extracts exhibited higher antibacterial activity [29].

3.3 Anti-Inflammatory Activity

Both post- and pre-treatment anti-inflammatory activities of the aqueous extract of fresh leaves of *Coccinia indica* were evaluated in rats at various dose levels using the carrageenan-induced paw oedema method. In post-treatment studies, a dose-dependent anti-inflammatory effect was observed in the dose range of 25–300 mg/kg which was equivalent to diclofenac (20 mg/kg) at 50 mg/kg [30]. 60% methanolic extract of *Coccinia indica* produced maximum anti-inflammatory activity even more than the standard drug, diclofenac sodium after 3 hours[31]. The aqueous extract of *Coccinia grandis* leaves and stem for the anti-inflammatory activity against formaldehyde-induced paw edema in rats[32].Formaldehyde induced inflammation results production of endogenous mediators, such as; histamine, serotonin, prostaglandins, and bradykinin which can be treated with *Coccinia grandis* extract[33].

3.4 Analgesic and Antipyretic Activity

Scientist evaluated methanolic extract of *C. cordifolia* for antipyretic activity at the doses of 100 and 200 mg/kg in yeast-induced fever. The extract showed antipyretic activity by elevating the prostaglandin biosynthesis. Prostaglandin is considered as a regulator of body temperature [25].Analgesic and antipyretic properties were evaluated using tail flick model and yeast-induced hyperpyrexia, respectively. The extract produced marked analgesic activity comparable to morphine at 300 mg/kg, which suggests the involvement of central mechanisms. A significant reduction in hyperpyrexia in rats was also produced by all doses of extract with maximum effect at 300 mg/kg comparable to paracetamol. Reported that this study has established the analgesic and antipyretic activity of *C. indica* and, thus, justifies the ethnic uses of the plant[30].The analgesic and antipyretic activity of the methanol extract (50, 100 and 200 mg/kg) of *Coccinia grandis* L., leaves was evaluated in rats and mice. Acetic acid induced writhing, Tail immersion and Hot plate models were used to assess analgesic activity and Yeast induced pyrexia model was used to evaluate antipyretic activity. Oral administration of methanol extracts significantly inhibits acetic acid induced writhing in mice in dose dependent manner but failed to show significant inhibition in Tail immersion and Hot plate models. Antipyretic study revealed that methanolic extract exhibits significant reduction in pyrexia that was comparable to standard drug[34]. Antipyretic property was assessed by using yeast inducing hyperpyrexia in rats on aqueous extract of fresh leaves which showed marked result showing the presence of this property [35]. Analgesic property was evaluated by using tail flick model in rats on the aqueous extract of fresh leaves of *C. indica* where prominent result has been reported[36].

3.5 Antinociceptive Activities

Antinociceptive activity tests were conducted in acetic acid-induced gastric pain writhing in a mouse model. The number of writhings was induced by intraperitoneal administration of acetic acid in mice. When the lowest dose of extract tested (100 mg per kg body weight) the number of writhings was reduced by 36.4%. When a dose of 400 mg per kg body weight was given, the extract reduced the number of writhings by 47.5%. Reported result was significantly higher when observed with a standard antinociceptive drug, aspirin[37]. The methanolic extract of leaf also demonstrated significant and dose-dependent antinociceptive activity.

3.6 Antioxidant Activities

Different parts of *Coccinia grandis* such as leaves, fruits and roots are used for several medicinal purposes like jaundice, diabetic, wound healing, ulcer, antipyretic and antioxidant activity [38]. The roots, stems, leaves and whole plant of *C. grandis* are used in the treatment of jaundice, bronchitis, skin eruptions, burns, insect bites, fever, indigestion, nausea, eye infections, allergy, syphilis, gonorrhoea, etc.[39, 40]. The antioxidant activities of the various fractions of the hydromethanolic extract of the leaves of *Coccinia grandis* L. Voigt. (Cucurbitaceae) was investigated and were compared to standard antioxidants such as ascorbic acid, curcumin, α-tocopherol, and butylated hydroxyl toluene (BHT) and all the fractions showed effective H-donor activity, free radical scavenging activity, reducing power, metal chelating ability and inhibition of β-carotene bleaching[10]. According to Bhadauria, the root extracts *Coccinia grandis* showed higher antioxidant activity [41]. Ethanol extract of root of *Coccinia grandis* which contain flavonoids are responsible for antioxidant activity [42]. Methanol extracts of the fruit of *Coccinia grandis* have the potent antioxidant activity. The antioxidant activity of *Coccinia grandis* is because of the reducing power ability, hydrogen peroxide scavenging

potential [32, 43]]. Ethanol and methanol extracts of *C.grandis* fruit shows the antioxidant activity [44]. *Coccinia grandis* stem extract contain solvent petroleum, chloroform and ethyl acetate which shows antioxidant activity and ethyl acetate extract indicates more potent antioxidant activity than petroleum extract [32]. Both cold and ethanol extracts showed high antioxidant property at 0.329 mg/ml and 0.326 mg/ml concentration when compared with standard Trolox[29]. Researcher reported that the extract of *C.grandis* contained the significant amount of total phenolics and flavonoids and showed a significant result in inhibiting DPPH, at of 250 µg/mL concentration.

3.7 Antihyperglycemic Activities

Antihyperglycemic activity study of leaf extract *Coccinia grandis* was done through oral glucose tolerance tests in glucose-loaded mice and it showed high activity at an extract dose of 400 mg per kg body weight of mice [37]. The antihyper glycemic potential of the plant *Coccini aindica* was showed a significant result in alloxan induced diabetic rats[46]].The preliminary investigation of aqueous leaf extract of C. grandis was found to be optimum effective dose at a dose of 0.75 gm/kg in diabetic rats and toxicologically safe as an antihyperglycemic agent in rats[47]. Furthermore, Munasinghe reported that leaves of *C. grandis* mixed with a measured amount of table salt and scraped coconut were able show severe hypoglycemic effects in a selected group of healthy subjects [21]. The oral administration of the pectin isolated from the fruit of *Coccinia indica* at a dose of 200 mg/100 g BW/day indicated a significant hypoglycemic action in normal rats [48].

3.8 Hepatoprotective Activity

Coccinia grandis Linn. (Cucurbitaceae) is a perennial branched handsome tendril climber which is used in traditional medicine for the treatment of jaundice. The ethanolic extract of *Coccinia grandis* leaves showed a significant ($p<0.05$) effect at an oral dose of 200 mg kg^{-1} compared to silymarin, the positive control [49]. The ethanolic extract of *Coccinia grandis* roots produced a significant ($P<0.01$) reduction in hepatic serum enzyme SGOT, SGPT, SALP compared to paracetamol treated group showing hepatoprotective action [42]. A diethyl ether extract of *Coccinia indica* leaves and aqueous fruit extract showed a significant effect of hepatoprotective activity against carbon tetrachloride induced liver toxicity in rats [50, 51]. Ethanolic extract of fruit and leaves of *Coccinia indica* exposed the presence of saponins. The ethanolic extract of *Coccinia indica* in the dose of 25 mg/kg and 50 mg/kg showed noteworthy dose dependent reduction in SGPT,SGOT, total protein, bilirubin, lipid peroxide levels compared to the standard, silymarin (25 mg/kg) [52].

3.9 Antiulcerogenic Effect

Researcher resported that the plant has antiulcerogenic effect. Methanol extract (2g/kg), aqueous extract (2g/kg) and powder (0.5-2 g/kg) of leaves of *C. cordifolia* were tested for antiulcer activity in Wistar albino rats. Aspirin (200mg/kg bw) in 1% sodium was used as control, famotidine (20mg/kg bw) in 1% sodium was used as standard drug. Powder of leaf and methanol extract showed significant decrease of ulcer, while aqueous extract showed no significant decrease [53]. In another study ethanolic, aqueous, total aqueous extracts (200 and 400 mg/kg) of leaves of *C. cordifolia* (Linn.) were used for anti-ulcer activity. Omeprazole (2mg/kg) was used as standard drug. The ethanolic extract 400 mg/kg showed comparable anti-ulcer activity as that of standard omeprazole [38, 54].

3.10 Antihepatotoxic Activity

Ethanolic extract of fruit and leaves of *C. cordifolia* revealed the presence of saponins. The purified fraction Ci from ethanolic extract by gradient silica gel column chromatography in the dose 25 mg/kg (Ci-1) and 50 mg/kg (Ci-2) (p.o.) showed significant dose dependent reduction in SGPT,SGOT, bilirubin, total protein, liver weight and lipid peroxide levels with reference to the standard, silymarin (25 mg/kg, p.o).The Ci compound also revealed significant dose dependent reduction in the hepatic antioxidant enzyme activities such as super oxide dismutase, glutathione, catalase, and peroxidase. The structural characterization of Ci compound by microanalysis, UV, IR, H NMR, C NMR spectroscopy and Mass spectrometry revealed structure with molecular formula C H O (beta-sitosterol). Hepatoprotective potential of Ci compound, sitosterol was inferred from its antihepatotoxic activities on serum transaminases and hepatic antioxidant enzymes in CCl4 intoxicated rats [52].

3.11 Antitussive activity

C. cordifolia has been extensively used to get relief from asthma and cough by the indigenous people of India. The antitussive effect of aerosols of two different concentrations (2.5%, 5%w/v) of methanol extract of *C. cordifolia* fruits were tested. The results reported significant reduction of cough number obtained in the presence of both concentrations of methanol extract as compared to the prototype antitussive agent codeine phosphate. Also, methanol extract exhibited significant antitussive effect at 100, 200 and 400 mg/kg, per orally by inhibiting the cough by 20.57, 33.73 and 56.71% within 90 min of performing the experiment [55].From this investigation, it can be concluded that on preliminary screening the extract of *C. cordifolia* produced a significant anti-tissue effect and thus the claim of using the plant as an anti-cough agent in ancient folklore medicine was established [56].

4. Conclusion

In a nutshell, *Coccinia cordifolia* is a true miracle of nature because of the presence of effective chemical constituents responsible for diversified pharmacological applications. Also, it has been developed by some medicinal industries as a drug. Far reaching written works study and scan for Ethnopharmacology need taken put around the world which uncovered that *C. cordifolia* may be a significant wellspring for numerous pharmacological furthermore medicinally significant chemicals. Again from the above discussion, it is cleared that Ivy gourd can compete existing medicines to cure some critical diseases as well. This review provides an outlook on various aspects which can further help to develop research on *Coccinia cordifolia* in order to discover more information on the existing activities or new ones.

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