



## Review Article

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### A REVIEW ON *LONI* (*PORTULACA OLERACEA* L.) IN KIDNEY DISEASES: A BOON FROM NATURE THROUGH *AYURVEDA*

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#### ABSTRACT

In today's era, medicinal plant resources are constantly depleting due to destructive harvesting. The scarcity of medicinal plants has put a threat to *Ayurveda*. The plants found in the ecology have certain positive effects on our human body, which remain to be disclosed and discovered. Diet is also important in fighting the disease. Kidney disease can only be managed not only with medicines but also with a proper diet plan. Out of innumerable medicinal and edible plants, *Loni* (*Portulaca oleracea* L.) is one of them which possesses innumerable therapeutic benefits. The study aims to procure the uses of *Loni* (*Portulaca oleracea* L.) in kidney diseases and determine if it can be used as a diet for the above disease. The study has been carried out based on modern phytochemistry, modern and *Ayurvedic* pharmacology keeping in view of *Ayurvedic* classics like *Kaiyadeva Nighantu*, *Bhavaprakasa Nighantu*, etc. of *Loni* (*Portulaca oleracea* L.) along with other experimental and evidence-based research papers. Purslane has massive action in delaying the progression of kidney disease through its nutritional benefits and value and its anti-nephrotoxic activity, which are being discussed in modern and *Ayurvedic* science. In managing kidney disease, the study has suggested that *Loni* (*Portulaca oleracea* L.) can be added as an edible vegetable as part of the diet plan.

**Keywords:** Ayurveda, edible vegetable, Kidney disease, *Loni*, *Portulaca oleracea* L., Purslane

#### INTRODUCTION

India has about 44% of flora which is used medicinally<sup>1</sup>. The medicinal plant resources are being constantly depleted due to destructive harvesting. The scarcity of medicinal plants has put a threat to *Ayurveda*. The plants found in the ecology have specific positive effects on our human body, which remain to be disclosed and discovered.

The kidney plays a vital role in maintaining the homeostasis of the body. Nephrotoxicity has become one of the significant causes of nephropathy in the world's population. Obesity, hypertension, diabetes mellitus and drugs are the major risk factor for renal dysfunction today. In modern medicine, angiotensin-converting enzyme inhibitors and angiotensin-renin blockers are the drugs of choice for managing progressive nephropathy. In the end stage, renal replacement becomes the only option for decreasing the progression. As a result, this increases both side effects and risks and the cost rates to which a few patients can avail themselves<sup>2</sup>.

Nowadays, people have started depending on processed and flavoured food, which results in different toxicity in the blood, and one of them is nephrotoxicity. The ingested poisonous food results in severe body malfunction and may even lead to death. About 20% of nephrotoxicity is induced and caused by drugs; this percentage is augmented in the elderly due to increased life span and poly-medications<sup>3</sup>.

Diet is also essential to fight the disease. Kidney disease can only be managed not only with medicines but also with a proper diet plan. Out of innumerable medicinal and edible plants, *Loni*

(*Portulaca oleracea* L.) is one of them which possesses numerous therapeutic benefits. Purslane (*Portulaca oleracea*) is listed by the World Health Organization as one of the most used medicinal plants and is termed a 'Global Panacea'<sup>4</sup>.

The study has been carried out based on modern phytochemistry, modern and *Ayurvedic* pharmacology keeping in view of *Ayurvedic* classics like *Kaiyadeva Nighantu*, *Bhavaprakasa Nighantu*, etc. of *Loni* (*Portulaca oleracea*) along with other experimental and evidence-based research papers.

#### *LONI*

**Botanical name:** *Portulaca oleracea* L.

**Family:** *Portulacaceae*

***Ayurveda* synonyms:** *Lonika*, *Loni*, *Ghotika*<sup>5</sup>

#### **Vernacular names**

Assamese<sup>6</sup>: Malbhog-sak, Khutura, Noniya, Nunia sak

Bengali: Baraloniya, Badanuni, Baranunia

English: Garden Purslane, Common Indian Purslane

Gujrati: Luni, Loni, Moti Luni

Hindi: Khursa, Kulfa, Badi Lona

Kannada: Dudagorai, Doddagoni Soppu, Lonika, Loni

Malayalam: Koricchira, Kozhuppa, Kozuppa, Kozuppaccira

Marathi: Kurfah, Ghola

Punjabi: Lonak, Chhotalunia, Khurfa, Kwfa

Tamil: Pasalai, Pulikkirai, Paruppukkeerai, Kozhuppu

Telugu: Pappukura, Peddapavila Kura, Payilikura, Pavilikura

Urdu: Khurfa<sup>5</sup>

**Habitat:** All over India, cultivated as a vegetable. <sup>7</sup>

**Distribution:** India- Assam, Kashmir, Madhya Pradesh, Maharashtra, Manipur, Punjab, Rajasthan, Uttar Pradesh, Assam: Kamrup, Barak Valley, Bongaigaon. <sup>6</sup>

**Botanical description:** Succulent, prostrate, annual herbs, up to 50 cm long; leaves variable, obovate to spatulate, fleshy; flowers bright yellow, in terminal clusters or sometimes axillary clusters subtended by 2-8 involucre leaves; capsules ovoid or obovoid; seeds black, reniform, concentrically striate, muciculate. <sup>8</sup>

**Parts used:** The whole plant. <sup>8</sup>

## Ayurveda Pharmacology

Table 1: Ayurveda Pharmacology of Loni

Classics	Rasa	Guna	Virya	Vipaka	Karma	Therapeutic Uses
Charaka Samhita <sup>9</sup>	Madhura	Guru, Ruksha	Sheeta	-	Rechak	-
Sushruta Samhita <sup>10</sup>	Swadu, Kshara, Anurasa Lavana	Ruksha	Sheeta	-	Kaphaghna, Na ati pittala, Vatala, Sara	-
Bhavaprakasa Nighantu <sup>11</sup>	Patu	Ruksha, Guru	-	-	Vata-sleshmahara, deepana Vishanashini	Arshoghni, Agnimandya, Vakadosha, Vrana-gulmaghni, Swasa, Kasa, Prameha, Sotha, Netra roga
Kaiyadeva Nighantu <sup>12</sup>			-	-	Vata-sleshma hara, deepana	Arshoghni, Agnimandya, Visha nashini
Ayurvedic Pharmacopeia of India <sup>5</sup>	Amla	Guru, Ruksha, Sara	Ushna	Amla	Kaphahara, Pittakara, Vatahara, Cakshushya, Vanidosahara	Agnimandya Sotha, Arsha, Gulma, Prameha, Vrana <sup>5, 9-12</sup>

### Phytoconstituents of *Portulaca oleracea*

**Flavonoids:** Flavonoids are one of the main ingredients of *Portulaca oleracea* L. Highest amount is found in the root, followed by the stem and leaf. The major flavonoids are kaempferol, apigenin, luteolin, myricetin and quercetin<sup>13</sup>. The aerial parts of the plant consist of portulaccones A, portulaccones B, portulaccones C, and portulaccones D<sup>14</sup>.

**Alkaloids:** N-trans-feruloyl tyramine and a higher concentration of dopamine and noradrenaline are found in leaves<sup>15,16</sup>. Oleracin E, oleracin A, and oleracin B are the other alkaloids present in the stem of the plant<sup>17</sup>.

**Terpenoids:** Portuloside A and B, portulene are the main terpenoids in *Portulaca oleracea*<sup>18,19</sup>.

**Organic acids:** *Portulaca oleracea* is rich in polyunsaturated fatty acids (PUFA) and has been demonstrated to be one of the major plant sources of omega 3 and omega 6 fatty acids. Others, particularly alpha-linolenic acid and another essential fatty acid such as palmitic acid, palmitoleic acid, linoleic acid, oleic acid, etc<sup>16,20</sup>.

**Anthocyanins:** Anthocyanins are rich in leaves, stems and flowers of purslane, with antioxidant properties<sup>21</sup>.

**Other compounds:** Polysaccharides with potential therapeutic effects on diabetes were found in *Portulaca oleracea*<sup>16,20</sup>. Purslane is also a rich source of vitamin A, riboflavin, niacin, pyridoxine, vitamin C, thiamine,  $\alpha$ -tocopherol and pantothenic acid<sup>22,23</sup>.

### Nephro-pharmacology of *P. oleracea*

**Anti-nephrotoxic activity:** Aqueous and ethanolic extracts of *Portulaca oleracea* were examined on cisplatin-induced renal toxicity and changes in renal function. The study showed a marked improvement with a clear view of dose dependency<sup>24</sup>. Other results suggest that *Portulaca oleracea* extract may protect against cisplatin-induced renal toxicity and may help to limit renal injury<sup>25</sup>. The aqueous extract of *Portulaca oleracea* prevents the development of diabetic nephropathy by inhibiting renal fibrosis and inflammation in type 2 diabetic db/db mice. In this study, the metabolic factors such as advanced glycation end products (AGE) and transforming growth factor- $\beta$ 1 (TGF- $\beta$ 1) were markedly overproduced in untreated db/db mice. In contrast, the treatment with purslane significantly decreased AGE and TGF- $\beta$ 1 expression in the renal cortex of db/db mice<sup>26</sup>. The gentamicin-induced plasma levels of urea, uric acid and creatinine were significantly reduced after administration of *Portulaca oleracea*. The study also shows that *Portulaca oleracea* is enriched in omega-3 and omega-6 fatty acids, which can result in higher protection against gentamicin induced nephrotoxicity compared to fish oil<sup>27</sup>. *Portulaca oleracea* is rich in vitamins, minerals, antioxidant components, and omega-3 fatty acids, mainly  $\alpha$ -linolenic acid and eicosapentaenoic acid. Results showed a significant elevation of the liver and kidney functions, lipid profile and lipid peroxidation<sup>28</sup>.

**TNF- $\alpha$  and IL-6 inhibitory activity:** The effects of the different parts of *Portulaca oleracea* on cytokine, tumour necrosis factor- $\alpha$  (TNF- $\alpha$ ) and interleukin-6 (IL-6) secreted by adipose cells *in vitro* method showed improvement in the disorder of lipid in different degree by lowering the levels of TNF- $\alpha$  and IL-6<sup>29</sup>.

**Antidiabetic activity:** The polysaccharide extracted from *Portulaca oleracea* can control blood glucose and modulate the metabolism of glucose and blood lipids in diabetic mice<sup>30</sup>. The aqueous extract of *Portulaca oleracea* can lower hyperglycaemia and diabetic vascular inflammation by preventing the development of diabetic endothelial dysfunction in Type 2 Diabetes mellitus and its vascular complications<sup>31</sup>.

**Anti-hypertensive activity:** An intake of the aqueous extract of leaves and stems of *Portulaca oleracea* resulted in a dose-dependent contraction of the rabbit aorta<sup>32</sup>. The K<sup>+</sup> ion content of *Portulaca oleracea* is partly responsible for the relaxant effect observed on the isolated rat diaphragm<sup>33</sup>.

**Diuretic activity:** It is found that purslane has 43.7% diuretic activity compared with furosemide in mice<sup>34</sup>.

**DISCUSSION**

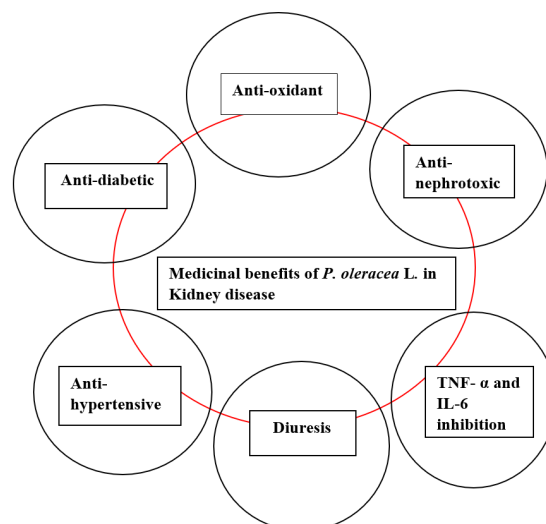
**Adenosine, Kidney disease and *Portulaca oleracea***

Adenosine is one of the alkaloids extracted from *Portulaca oleracea*<sup>17,35</sup>. The ethanolic extract from *Portulaca oleracea* results in increased Pyruvate kinase (PK), Phosphofructokinase (PFK) and Lactate dehydrogenase (LDH) and decreased the level of Adenosine triphosphate (ATP) in mice cortices compared to the hypoxic control group. The ethanolic extract from *Portulaca oleracea* has anti-hypoxic activity, which may promote the activity of the key enzymes in glycolysis and improve the level of ATP in hypoxic mice<sup>37</sup>.

Purslane possesses immense nutritional benefits with a great source of vitamins, minerals and omega-3 fatty acids<sup>36</sup> (Table 2). In a nutshell, *Portulaca oleracea* in treating kidney disease has numerous medicinal benefits (Figure 1).

**Table 2: Nutritional benefits of raw *Portulaca oleracea*<sup>36</sup>**

Principle	Nutrient value	Percentage of Recommended Dietary Allowance (RDA)
Energy	16 Kcal	1.5%
Carbohydrates	3.4 g	3%
Protein	1.30 g	2%
Total Fat	0.1 g	0.5%
Cholesterol	0 mg	0%
Vitamins	Folates	12 µg 3%
	Niacin	0.480 mg 3%
	Pantothenic acid	0.036 mg 1%
	Pyridoxine	0.073 mg 5.5%
	Riboflavin	0.112 mg 8.5%
	Thiamine	0.047 mg 4%
	Vitamin A	1320 IU 44%
	Vitamin C	21 mg 35%
Electrolytes	Sodium	45 mg 3%
	Potassium	494 mg 10.5%
Minerals	Calcium	65 mg 6.5%
	Copper	0.113 mg 12.5%
	Iron	1.99 mg 25%
	Magnesium	68 mg 17%
	Manganese	0.303 mg 13%
	Phosphorus	44 mg 6%
	Selenium	0.9 µg 2%
	Zinc	0.17 mg 1.5%



**Figure 1: Medicinal benefits of *Portulaca oleracea* in kidney disease**

**Ayurveda**

In *Ayurveda*, the pathogenesis of kidney disease (*Vrikka roga*) is scattered as various disease like *rasa pradosaj vikar* (diseases due to vitiated *rasa dhatu*), *Pandu* (anaemia), *Kaphaj sotha* (oedema), *Mutrakriccha* (dysuria), *Mutraghata* (retention of urine), *Prameha* (Diabetes mellitus) and its *upadrava* (complications). In the pathogenesis, with the vitiation of *Samana vayu* (located in the stomach), *Apana vayu* (located in the large intestine), the *Vyan vayu* (located all over the body) also gets affected. So, in a nutshell, the whole physiology of the human body gets imbalanced, and various complications occur. It can be enumerated under *tridoshaj vyadhi* (disease involving all three *dosha*, *Vata*, *Pitta*, *Kapha*) with *agnimandya* (indigestion) as a prime reason.

As mentioned in *Bhavaprakasa* and *Kaideva Nighantu*, *Loni* is *Vata-Sleshmahara* and *Deepana* (stimulate the digestive fire). Therefore, it ignites the *jatharagni* (digestive fire located in the lower stomach and intestine) as well as *dhatwagni* (digestive fire located in *dhatu*s or tissues) and helps in the proper nourishment of the cells and preventing it from further damage. On the other hand, in the classics, it has been mentioned that *Loni* has *vishanashini* (antidote) property. So, the nephrotoxicity in the diseased kidney decreases as it also works as an anti-nephrotoxic agent. The other therapeutic uses mentioned are *Prameha* (Diabetes mellitus) and *sotha* (oedema) where, both of which are one of the prime clinical features of *vrikka roga* (kidney disease).

**CONCLUSION**

*Loni* (Purslane) has immense action on delaying the progression of kidney disease through its nutritional benefits and value and its nephron-pharmacological solid activity, which are being discussed in modern and *Ayurvedic* science. It is an excellent source of omega-3 fatty acids, which helps lower the risk of kidney disease. And most importantly, adenosine, one of the major alkaloids of *Portulaca oleracea*, serves as the mediator of tubuloglomerular feedback and maintains renal vascularity.

**FUTURE PROSPECTS**

This review has tried to put forward that *Loni* (*Portulaca oleracea*) is a potent nutraceutical medicinal plant which can be

taken as an edible vegetable orally in the diet with proper concern in the amount.

## REFERENCES

- Shiva MP. Inventory of Forestry Resources for Sustainable Management and Biodiversity Conservation. New Delhi: Indus Publishing Company; 1998.
- Jameson J Larry, Loscalzo Joseph. Harrison's nephrology and acid-base disorder. Chapter 11. 3<sup>rd</sup> edition. 2016. McGraw Hill Education (India) Private Limited, B-4, Sector-63, Dist. Gautam Budh Nagar, Noida
- Al-Naimi MS, Rasheed HA, Hussien NR, Al-Kuraishy HM, Al-Gareeb AI. Nephrotoxicity: Role and significance of renal biomarkers in the early detection of acute renal injury. J Adv Pharm Technol Res 2019; 10(3): 95–99.
- Shanker N, Debnath S. Impact of dehydration of purslane on retention of bioactive molecules and antioxidant activity. J Food Sci Technol 2015; 52: 6631–6638.
- Anonymous. The Ayurvedic Pharmacopoeia, Part-I, Volume-II, first ed. Government of India, Ministry of Health and Family Welfare, Department of Ayurveda, Yoga-Naturopathy, Unani, Siddha & Homeopathy, New Delhi: P 102-104; 2006
- Barooah Chandra, Ahmed Iftikher. Plant Diversity of Assam: A checklist of Angiosperms and Gymnosperms. Assam Science Technology and Environment Council, Assam, India: P 51; 2014
- Khare C.P. Indian Medicinal Plants: An Illustrated Dictionary. Springer, New York: P 513; 2007
- Anonymous. Database on Medicinal plants used in Ayurveda. Volume 3. Central Council for Research in Ayurveda and Siddha. Deptt. Of ISM and H, Ministry of Health and Family Welfare, Government of India: P 387; 2000
- Charaka. *Charaka Samhita*, Savimarsha vidyotini, edited by Kashinath Shastri, Dr Gorakhnath Chaturvedi. *Sutra sthan, Anapanavidhi adhyaya*, Verse 100. Chaukhamba Prakashana, Varanasi. 2004
- Sushruta. *Sushruta Samhita*, edited by Dr Ambikadutta Shastri. *Sutra sthan, Anapanavidhi adhyaya*, Verse 274-275. Chaukhamba Prakashana, Varanasi. 2012
- Bhavmishra. *Bhavaprakasa Nighantu*, commented by Prof. K C Chunekar, Edited by Lt. Dr G S Pandey. *Purvakhanda, Mishraprakaran, Shakavarga*, Verse 16-17. Choukhambha Prakashani, Varanasi. 2010
- Sharma PV, Sharma Guruprasada. *Kaiyadeva Nighantu*. 2<sup>nd</sup> edition. *Pathyapathya Vibhodak, Aushadhi varga*. Verse 649. Choukhambha Prakashani, Varanasi. 2006
- Zhu H, Wang Y, Liu Y, Xia Y, Tang T. Analysis of flavonoids in *Portulaca oleracea* L. by UV-vis spectrophotometry with comparative study on different extraction technologies. Food Anal. Methods 2010; 3(2): 90–97.
- Xu X, Yu L, Chen G. Determination of flavonoids in *Portulaca oleracea* L. by capillary electrophoresis with electrochemical detection. J Pharm Biomed Anal 2006; 41(2): 493-499
- Yue ME, Jiang TF, Shi YP. Simultaneous determination of noradrenaline and dopamine in *Portulaca oleracea* L. by capillary zone electrophoresis. J Sep Sci 2005; 28(4): 360–364
- Petropoulosa S, Karkanisa A, Martinsb N, Ferreirab I C.F.R. Phytochemical composition and bioactive compounds of common purslane (*Portulaca oleracea* L.) as affected by crop management practices. Trends Food Sci Technol 2016; 55: 1-10
- Xiang L, Xing D, Wang W, Wang R, Ding Y, Du L. Alkaloids from *Portulaca oleracea* L. Phytochemistry 2005; 66(21): 2595-2601
- Sakai N, Inada K, Okamoto M, Shizuri Y, Fukuyama Y. Portuloside A, a monoterpene glucoside, from *Portulaca oleracea*. Phytochemistry 1996; 42(6): 1625-1628
- Elkhayat ES, Ibrahim SR, Aziz MA. Portulene, a new diterpene from *Portulaca oleracea* L. J Asian Nat Prod Res. 2008; 10(11-12): 1039–1043
- Zhou YX, Xin HL, Rahman K, Wang SJ, Peng C, Zhang H. *Portulaca oleracea* L.: A Review of Phytochemistry and Pharmacological Effects. Biomed Res Int 2015; 2015: 925631
- Silva R, Carvalho IS. *In vitro* Antioxidant Activity, Phenolic Compounds and Protective Effect against DNA Damage Provided by Leaves, Stems and Flowers of *Portulaca oleracea* (Purslane). Nat Prod Commun 2014; 9(1): 45-50
- Chugh V, Mishra V, Dwivedi SV, Sharma KD. Purslane (*Portulaca oleracea* L.): An underutilized wonder plant with potential pharmacological value. Pharma Innov 2019; 8(6): 236-246
- Guil-Guerrero JL, Rodríguez-García I. Lipids classes, fatty acids and carotenes of the leaves of six edible wild plants. Eur Food Res Technol 1999; 209: 313-316
- Mohamed AI, Hussein AS. Chemical composition of purslane (*Portulaca oleracea*). Plant Foods Hum Nutr 1994: 1-2
- Karimi Gr, Khouei A, Omidi A, Kalantari MR, Babaei J, Taghiabadi E, Razavi BM. Protective Effect of Aqueous and Ethanolic Extracts of *Portulaca oleracea* Against Cisplatin Induced Nephrotoxicity. Iran J Basic Med Sci 2010; 13(2): 31-35
- Lee AS, Lee YJ, Lee SM, Yoon JJ, Kim JS, Kang DG, Lee HS. An Aqueous Extract of *Portulaca oleracea* ameliorates Diabetic Nephropathy Through Suppression of Renal Fibrosis and Inflammation in Diabetic db/db Mice. Am J Chin Stud 2012; 40(3): 495–510
- Hozayen W, Bastawy M, Elshafeey H. Effects of Aqueous Purslane (*Portulaca oleracea*) Extract and Fish Oil on Gentamicin Nephrotoxicity in Albino Rats. Nat Sci 2011;9(2)
- Seif MM, Madboli AN, Marrez DA, Aboulthana WM. Hepato-Renal protective Effects of Egyptian Purslane Extract against Experimental Cadmium Toxicity in Rats with Special Emphasis on the Functional and Histopathological Changes. Toxicol Rep 2019; 6: 625-631
- Xiao FY, Lu FE, Xu LJ. Effect of different parts of *Portulaca oleracea* on the levels of TNF-alpha and IL-6 in the supernatant of cultured adipose cell. China J Chinese materia medica 2005; 30(22):1763-1766
- Li F, Li Q, Gao D, Peng Y, Feng C. Preparation and antidiabetic activity of polysaccharide from *Portulaca oleracea* L. Afr. J. Biotechnol 2009; 8 (4):569-573
- Lee AS, Lee YJ, Lee SM, Yoon JJ, Kim JS, Kang DG, Lee HS. *Portulaca oleracea* Ameliorates Diabetic Vascular Inflammation and Endothelial Dysfunction in db/db Mice. Evid-based Complement Altern Med 2012; 2012: 741824
- Parry O, Okwuasaba F, Ejike C. Effect of an aqueous extract of *Portulaca oleracea* leaves on smooth muscle and rat blood pressure. J Ethnopharmacol 1988; 22(1):33-44
- Parry O, Marks JA, Okwuasaba FK. The skeletal muscle relaxant action of *Portulaca oleracea*. J Ethnopharmacol 1994; 40(3):187-94
- Lim JP, Suh ES. Hepatoprotective, Diuretic and Anti-inflammatory Activities of the Extract from *Portulaca oleracea* L. Korean J Medicinal Crop Sci 2000; 8(3): 189-193
- Wang F, Yuan Y, Qu L. Determination of adenosine in *Portulaca oleracea* L. by high-performance liquid chromatography. J Food Saf 2020; 11(14): 4625-4630

36. Purslane, Raw. <https://fdc.nal.usda.gov/fdc-app.html#/food-details/169274/nutrients> [Assessed on 14/03/2023]
37. Chen CJ, Wang WY, Wang XL, Dong LW, Yue YT, Xin HL, Ling CQ, Li M. Anti-hypoxic activity of the ethanol extract from *Portulaca oleracea* in mice. J Ethnopharmacol 2009; 124:246–250

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