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Evaluation of biological properties and clinical effectiveness of Aloe vera

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ABSTRACT:

Aloe vera is mostly known for its considerable medicinal properties. The chemistry of the plant has marked the presence of more than 200 different biologically active compounds. The biological properties of the Aloe species are associated with the inner gel of the leaves. Most research has been done on the biological activities of the different species of Aloe, including antibacterial and antimicrobial activities of the non-volatile substances of the leaf gel. Aloe species are widely distributed in the African and the eastern European area and are spread throughout the world. The genus Aloe has more than 400 species but few, such as Aloe ferox, and Aloe arborescens. A. vera has various medicinal properties such as anticancer, antidiabetic, antitumor, antiarthritic, and anti-rheumatoid, properties. In addition, A. vera has also been promoted for, gastrointestinal disorders, and immune system deficiencies. However, not much information is available on the properties of the gel components. The current review focuses on the composition of Aloe gel, its various photo components has different biological properties which help to improve health and prevent disease conditions.

Keywords: Aloe vera biological properties photo components review clinical effectiveness

INTRODUCTION:

Aloe vera is one of the plant from 400 species of Aloe belonging family Liliaceae that originated from South Africa but have been indigenous to dry subtropical and tropical climates, including the southern USA (Reynolds T *et al*., 1999) Recently, only a few species of Aloe having commercial importance, for which A. vera is contain the most potent and, thereby, the most popular plant in the research field. A. vera has been used as a natural medicine for over 2000 years and has remained an important component in the traditional medicine of many cultures, such as China, India, the West Indies, and Japan (Fostar M *et al.*,2011)

Figure 1: Aelo vera plant

A.vera is a luscious plant. luscious are xerophytes, which are adapted to living in areas of low water availability and are characterized by possessing a large water storage tissue. The main feature of the A. vera plant is its high-water content, ranging from 99 to 99.5%. In compositional studies on the structure of the A. vera plant leaf portions, the rind was found to be 20 to 30% and the pulp 70 to 80% of the whole leaf weight. On a dry weight basis, the percentages of the rind and pulp represented as lipids (2.7% and 4.2%) and that as proteins (6.3% and 7.3%) only accounted for a minor fraction (Femenia A *et al.*,1999). However, the non-starch polysaccharides such as chitin and lignin represented the bulk of each leaf fraction and were found to be 62.3% and 57.6% of the dry weight of the rind and pulp, respectively. A. vera gel polysaccharides consist of linear chains of glucose and mannose molecules, the molecules are referred to as polymannans because mannose is more concentrated than glucose (Ni Y *et al.,* 2004). These are linear chains ranging in size from a less to several thousand molecules (Hutter JA *et al.*,1996) The major polysaccharide known as acemannan, is composed of one or more polymers of different chain lengths with molecular weights ranging from 30 kDa to 40 kDa or greater, and consisting of repeating units of glucose and mannose in a 1:3 ratio (Femenia A *et al.*,1999).

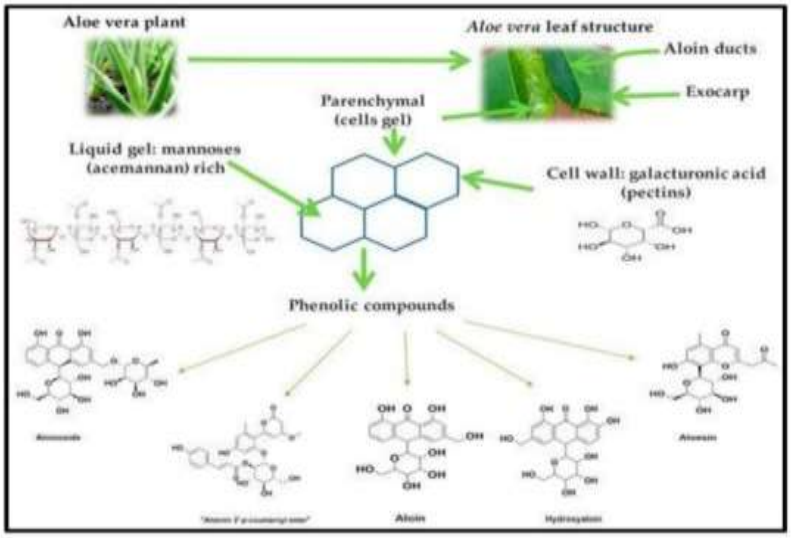

Figure 2: *Aloe vera* plant and chemical structure of its main components (Tornero-Martínez *et al., 2014)*

In western societies, especially in the USA, A. vera has been grown mainly to supply the latex component of the leaf to the pharmaceutical industry (Lee KY *et al.*,2000). However, over the last decade, various Aloe species have gained popularity as therapeutic botanicals and for utilizing biological properties large industry has developed.1 Many investigators aim is to establish the active principles in A. vera gel. because of its curative and therapeutic properties, it has been used for many centuries and although from inner gel almost 75 active compounds are identified, therapeutic effects of A. vera have not connected well with each component (Habeeb F *et al.,* 2007). Many of the medicinal effects of Aloe leaf extracts have been credited to the polysaccharides found in the inner leaf However, rather than a single chemical substance the biological activities should be assigned to synergistic actions of compounds (Avijgan M *et al.,* 2014). The Aloe tissue contains proteins, lipids, amino acids, vitamins, enzymes, inorganic compounds, and small organic compounds with different carbohydrates (Hamma J H *et al.,* 2008).

The species of Aloe selected for commercial utilization, would be based on its local availability and distribution. In India, the most widely distributed Aloe species are Aloe Barbadensis. Various extracts of these Aloe species are traditionally used to cure arthritis, skin cancer, burns, eczema, psoriasis, digestive problems, high blood pressure, and diabetes.13 As different Aloe species would have different phytochemical contents based on interspecies variation, varying climate and soil conditions, direct correlation of biological activity would be imperfect.

Due to the presence of polysaccharides in the pulp Many beneficial effects of this plant have been attributed. to treat various skin conditions such as cuts, burns and eczema the clear pulp which is also known as Aloe vera gel is widely used in various medical, cosmetic, and nutraceutical applications (Hamma J H *et al.,* 2008). Research have marked higher antioxidative activities present in its pulp.14 it is used externally (Serrano *M et al.,* 2006). *These* Aloe species are in form of main Aloe, extract and powder form is currently listed in the pharmacopoeia of many countries (Park YI *et al.,* 2006).

A. vera is known for important secondary metabolites (Reynolds T *et al.*, 1999). the major secondary metabolites are Anthraquinones and tricyclic aromatic quinines. Aloe-emodin and chrysophanol are the major compounds Among the naturally occurring anthraquinone derivatives (Tan Z *et al.*, 2011). The tricyclic aromatic quinines of Aloe have been proposed via the type III polyketide biosynthesis pathway. Recently, novel plant-specific type III polyketide synthases (PKS), and octapeptide synthases, were isolated from Aloe arborescens and their functions were examined in *E. coli* (Mizuuchi Y *et al.*, 2009). These novel plant enzymes might potentially be associated with the biosynthesis of natural tricyclic aromatic quinines in Aloe, but it remains unclear whether these enzymes produce end products such as Aloe-emodin and chrysophanol in vivo (Lee YS *et al.*, 2013). Aloesin, aloin, and Aloe-emodin (oxidative product of aloin) are the foremost necessary secondary metabolites found in A. vera gel. Many secondary metabolites in plants have reported potent anti-inflammatory, lipid-lowering, and antioxidant activities (Rajasekaran S *et al.*,2006). However, no reports have elucidated the complete entire secondary metabolites present in the plant species.

CLINICAL EFFICACY AND MECHANISM OF ACTION

2.1. BURN WOUND HEALING EFFECT

Aloe is known as the healing plant. A. vera has been used for traditional medicinal purposes in several cultures (Grace OM *et al.*, 2008). the proliferation of several cell types stimulated by In vitro extracts of A. vera. studies have shown that treatment with A. vera gel extracts helps in quicker healing of wounds. A. vera may have a direct effect on the wound healing process, which is manifested by an increase in the rate of contraction of wound area (Subramanian S *et al., 2006)* and the effect of A. vera on increasing wound contraction and collagen synthesis has been confirmed. This property is attributed to the mannose-6phosphate known to be present in A. vera gel. The proliferation of fibroblasts and the production of hyaluronic acid and hydroxyproline in fibroblasts promoted by the polysaccharides from aloe, during wound healing play important roles in extracellular matrix remodeling during wound healing (Chantarawaratit P *et al.*,2013). Acemannan, considerably will increase dental medicine ligament cell proliferation, upregulation of growth/differentiation issue five, sort I albuminoid, and alkaline enzyme activity in primary human dental medicine ligament cells. In a clinical study, to check the efficacy of A. vera gel compared with 1% silver sulfadiazine cream as a burn dressing for the treatment of superficial and partial thickness burns, healing of burn wounds was remarkably early in A. vera treated patients than those patients treated with 1% silver sulfadiazine (Chantarawaratit P *et al.*,2013) Polysaccharides isolated from A. vera induce matrix metallopeptidase (MMP)-3 and metallopeptidase inhibitor-2 gene expression during the skin wound repair of rats, which directly helps to regulate the wound healing activity of A. vera gel.

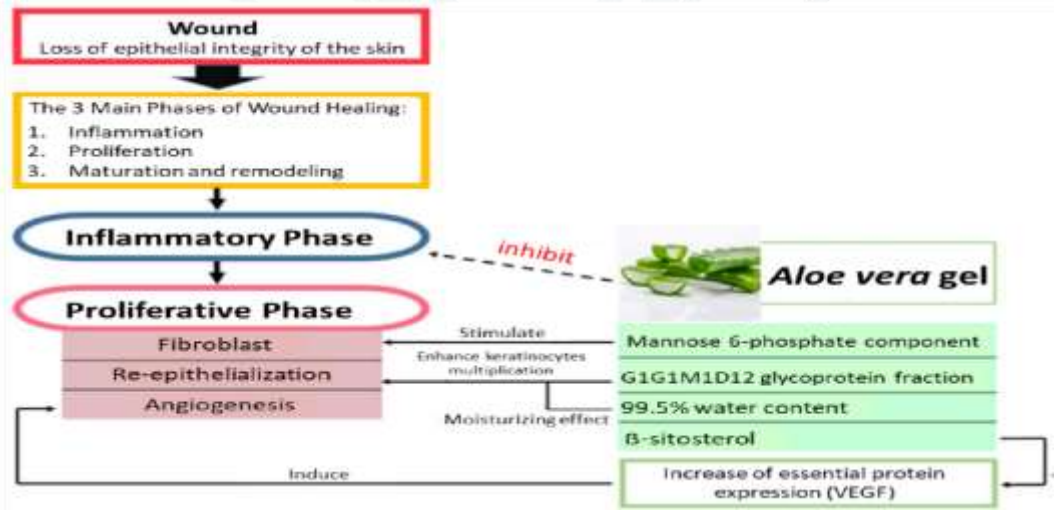

Figure 3: The molecular mechanism of Aloe vera (Aloe barbadensis Miller) in the wound healing process (Nur Atik1 *et al., 2019)*

2.2 ANTIDIABETIC EFFECT

By the Clinical studies it has been suggested that A. vera gel is act as a safe antihyperglycemic and antihypercholesterolemic agent specific to type 2 diabetic patients without any effects on normal blood lipid levels or liver/kidney function (Huseini HF *et al.*, 2012). In vivo and in vitro studies strongly

demonstrate that the water-soluble fraction of Aloe spp. possesses glucose-lowering activities which modulate glucose transporter-4 mRNA expression. In a randomized controlled trial, A. vera gel complex reduced weight, body fat mass, and internal secretion resistance in fat prediabetes and early nontreated diabetic patients (Devaraj S, Jialal R *et al.,* 2008). Further, in a pilot study, two Aloe products in patients with prediabetes over 8 weeks, tended to revert the impaired fasting glucose and impaired glucose tolerance observed in conditions of prediabetes/ metabolic syndrome (Devaraj S, Jialal R *et al.,* 2008). One study discussed the efficacy of aloe emodin-8-O-glycoside isolated from A. vera gel increase glucose transport by modulating the proximal markers involved in glucose uptake and its transformation into glycogen (Anand S, Muthusamy VS *et al.,*2010). Tanaka et al reported reductions in both fasting and random blood glucose levels of db/db diabetic mice chronically treated with the same phytosterols from A. vera gel (Tanaka M *et al.,* 2006). it is studied that A. vera gel has significant antidiabetic activity as it reduced oxidative stress in streptozocin which induced diabetic rats and improved status of antioxidant (Jain N *et al.*, 2010). A. vera gel also helps to improve the carbohydrate metabolism, recent studies suggests that it helps to improve the metabolic condition in prediabetes and early non-treated diabetic patients by reducing body weight, by reducing body fat mass, fasting blood glucose, and fasting serum insulin in individuals.44 Shin et al shown that dietary Aloe formula also reduces obesity-induced glucose tolerance by inducing anti-inflammatory cytokines in the white adipose tissue and liver, which are important peripheral tissues affected by insulin resistance (Shin E *et al.,* 2011). A. vera additionally has shown improvement within the function of isolated rat duct gland islets whereby it raised survival of the islet cells, their mitochondrial activity, and hormone levels at constant time as reducing the assembly of reactive element species.

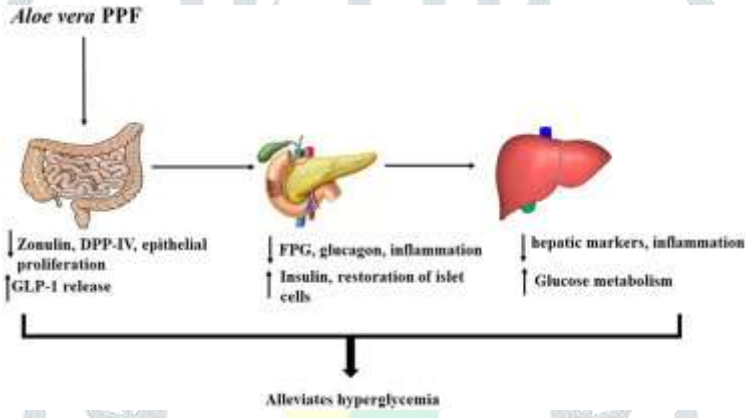

Figure 4: Aloe vera in diabetes mellitus (Spoorthy N *et al.,*2021)

2.3 EFFECTS OF ALOE GEL ON LUNGS OF CIGARETTE SMOKER

As already it is known, because of cigarette smoke exposure that the number of Chronic Obstructive Pulmonary Disease (COPD) patients could increase because of cigarette smoke exposure. The cigarette smoke that is inhaled into the lungs rose alveolar macrophage cells as the body's initial defence response. This is evidenced by an increase in the number of alveolar macrophages isolated from the broncho-alveolar lymphoid tissue (BALT) in lung smokers. The toxin content in cigarette decreases the expression of Toll-like receptor 2 (TLR2), which is followed by the decreased activity of macrophage phagocytosis. Exposure to cigarette smoke may also induce the incidence of alveolar epithelial cell apoptosis and pulmonary vascular endothelial cells by suppressing Bcl2 protein expression through inhibition of the release of cytochrome C from mitochondria (Atik N *et al.,* 2012).

We did a study on experimental animals by exposing the rats to cigarette smoke and administered Aloe gel for 42 days. After that, the lungs of mice were taken for later examinations, which are several macrophage observations, macrophage phagocytosis test, as well as immunohistochemistry with an anti-Bcl2 antibody. It proves that exposure to cigarette smoke can increase the number of macrophages in the lungs and Aloe gel can prevent the process of the increment. The results are due to the presence of vitamin C and sterols in Aloe gel which is known as an antioxidant and anti-inflammatory by inhibiting acute inflammatory processes (Williamson G *et al*., 2011). Studies showed that the group given exposure to cigarette smoke without Aloe gel administration have a less alveolar macrophage phagocytosis activity then the control group (Williamson G *et al*., 2011).

Interestingly, the group present in the Aloe gel had more macrophage activity than the control group. Results explained that the presence of long-chain polysaccharide molecules like acemanna in Aloe gel that

can modulate the immune system by increasing the production as well as by improving macrophage activity (Williamson G *et al*., 2011).

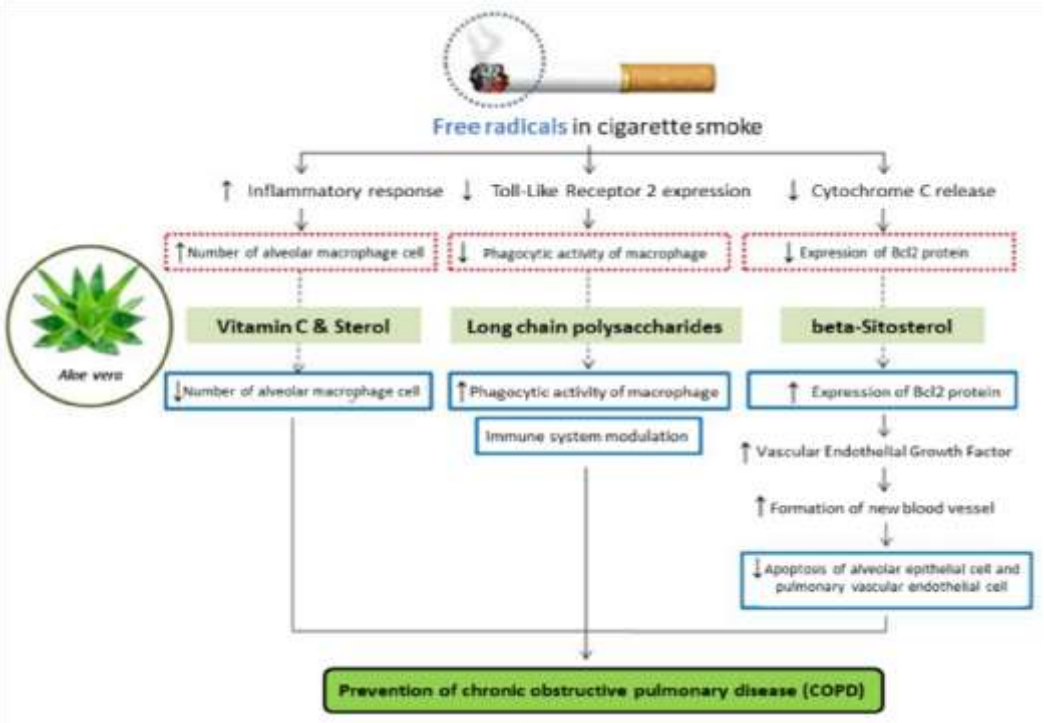

Figure 5: The molecular mechanism of aloe vera in the prevention of COPD from cigarette smoke consumption (Atik N *et al.*, 2012).

The beta-sitosterol content in Aloe gel can increase the expression of Bcl2, which will suppress the occurrence of cell apoptotic process in alveolar. Thus, the administration of Aloe gel is expected to decrease the incidence of cell apoptosis in the lung induced by cigarette smoke.

2.4 ANTIOXIDANT EFFECT

1. A. vera contains some amounts of antioxidants which includes a-tocopherol (vitamin E), carotenoids, ascorbic acid (vitamin C), flavonoids,4 and it has been suggested that antioxidant action may be an important property of plant medicines used in the treatment of various diseases. Aloe gel can scavenge the free radicals 2,2-diphenyl-1picrylhydrazyl (DPPH), 2,20-azinobis-(3-ethylbenzothiazoline-6sulfonic acid) (ABTS)þ, and nitric oxide in a concentration-dependent manner, as seen in an in vitro study of the radioprotective efficacy of A. vera gel (Saini DK *et al.*, 2011). Application of ethanolic extract of A. vera gel on tissue antioxidants led to a reduction in blood glucose levels in diabetic rats, which helps to prevent excessive formation of free radicals through various biochemical pathways and also reduces the potential of the enzymes (Rajasekaran S *et al.*, 2005). In vitro and in vivo antioxidant potentials of a polysaccharide isolated from A. vera gel were investigated. Using Digestive enzymes like carbohydrases and proteases. Enzymatic extracts were prepared from A. vera gel. Results suggested that Aloe polysaccharides exhibited a protective effect against induced oxidative stress and cell death in kidney epithelial cells (Vero cells) as well as in an in a vivo zebrafish model. One study shows the total phenolic content of A. vera leaf skin extracts and a significant correlation was established between the total phenolic content to increase the antioxidant capacity (Kammoun M *et al.*, 2011). The methanol extracts of leaf skins and flowers of A. vera were also screened for their antioxidant activities, and in vitro antioxidant activities of both extracts exhibited, with the leaf skin extract being the most active (Lopez A, *et al.*, 2013).

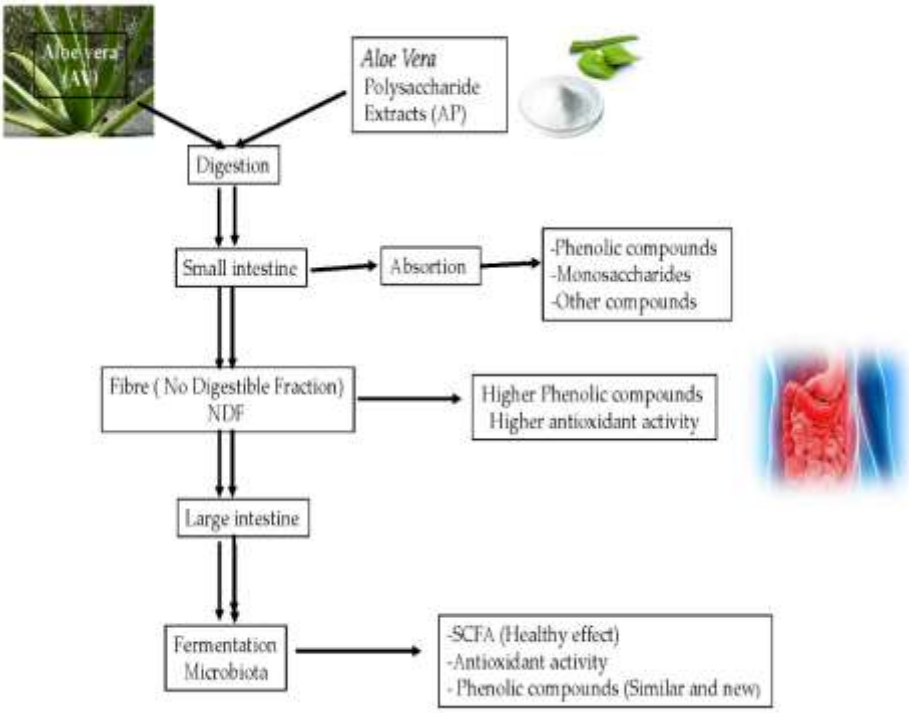

Figure 6: Antioxidative effect of aloe vera gel (Antonio T *et al.,* 2019).

2.5 ANTICANCER ACTIVITY

Aloin, associate degree anthraquinone being a natural compound and therefore the main ingredient of succulent, has been documented for its outstanding potential therapeutic choices in cancer, whereby it showed chemoprotective effects against one,2-dimethylhydrazine-induced preneoplastic lesions within the colon of Wistar rats (Hamiza OO *et al.,* 2014). Aloin treatment may inhibit the secretion of VEGF in cancer cells. Aloin treatment significantly inhibited in vitro VEGF-induced angiogenic response of human endothelial cells, causing inhibition of proliferation and migration of endothelial cells.59 Aloe-emodin (AE), is also a subtype of anthraquinone, a natural compound that has traditionally been found to have diverse biological activities including anticancer functions.60,61 AE (1,8-dihydroxy-3hydroxymethyl-9,10-anthracenedione) is an herbal anthracenedione derivative from A. vera leaves. The inhibitory effect of Aloe vera on the activity and gene expression of enzyme like N-acetyl transferase, which plays an important role in the metabolism of aryl amine carcinogens, was found in human malignant melanoma cells (Lin JG *et al.,* 2006). Recently, Lin et al demonstrated AE-induced apoptosis in the T24 human bladder. Aloin, derived from A. vera leaves, has been shown to possess anticancer potential activities (Lin JG *et al.,* 2006). as it inhibits tumor angiogenesis and growth via blocking signal transducer and activator of transcription 3 activations, with the potential of a drug candidate for cancer medical care.66 Anthraquinone derivatives like emodin-like natural (emodin, rhein, and aloin) and artificial (anthraquinone-2-sulfonic acid) anthraquinones have recently been shown to guard in models of amyloid b and t aggregation-induced cell death through anti-aggregation properties, and/or enhancing the phosphatidylinositol-3-kinase/ protein kinase B survival mechanism, which suggests that anthraquinone-2-sulfonic acid could be a new neuroprotective compound and a novel caspase inhibitor (Das S *et al*., 2011).

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