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Analytics Detection of Phytochemical Compounds in *Cinnamomum zeylanicum* Bark Extract

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Abstract

Background: CinnamomumzeylanicumNees (Lauraceae) is used as a spicy culinary herb in the conventional eastern region. Cinnamon bark is a rich part in phytochemical compounds, bioactive phenolic compounds, and vitamins that are constituted a therapeutic chemical composition. The extract of cinnamon bark was identified as a potent source of antioxidants, and anti-inflammatory compounds. Aim: detection of the qualitative and quantitative various antioxidant compounds from *C.zeylanicum* barks using classical extraction and HPLC methods. Methodology: the preparation of water and ethanol extract Cinnamon bark powder at a ratio of (1:10). Different experimental methods have been used to indicate phytochemical constituents in cinnamon water extract using various chemical reagents. HPLC method was used to quantify the phenols and vitamins in cinnamon extract bark. Results: the qualitative detection of phytochemical compounds in cinnamon water extract showed the presence of saponins, steroids, alkaloids, phenols, tannins, flavonoids, coumarins, and resins. Quantification detection of trace elements (Zn,Se, Cu, Fe, Mn, Co, V, Ni, and Mo) helpskeep oxidative/antioxidant balance in mammalianorganisms.The present study investigated the roll of cinnamaldehyde and eugenolas a major phenolic compounds that may be responsible for the observed antioxidant activity in water extract of cinnamon bark.The result showed a variety of phenolic compounds (quercetin, gallic acid, rutin, kaempferol, lignin, and pyrogallol) that have an antioxidant activity and anti-inflammatory effect in different mechanisms. Vitamins gave an interesting results by the indicated concentration of fat-soluble vitamins (A, E, D, K) and water-soluble vitamins (C, B1, B2) in water extract and ethanol extract of bark. Conclusion: Cinnamomumzeylanicum bark has bioactive compounds responsible for antioxidant, antidiabetic, and anti-inflammatory activities. Therefore, it can be considered a traditional medical plant to prevent disease, and further investigations for more cinnamon properties should be conducted on this abundant plant which acts as a natural source of alternative medical drugs.

Keywords: Cinnamon bark; race elements; phenolic compounds; vitamins, antioxidants; alternative medicine

Introduction

Cinnamomum Zeylanicum (CM) or true cinnamon is the most well-known type of cinnamon that belongs to Lauraceae family growing in Sir Lanka[1].CM is a popular traditional herpes in the world, its aroma and sweet taste made it in the primary of list spices in various food plats. A variety of bioactive compounds have been isolated from different parts of the plant, thus, CM has a potent therapeutic ability to remove or treat many diseases[2]. Cinnamon is a natural phytochemical antioxidant that has shown a curative effect to reduce oxidative stress due to chronic diseases[3]. Therefore, research on herbs antioxidant activity have increased because of availability and abundance[4]. Cinnamon is one of many plants classified as a source of antioxidants that have a wide spectrum of primary, and secondary phytochemical compounds[5]. Phenols and flavonoids compounds in plants characterize as a reducing agents by the ability to donate electrons to oxidant species, scavenge free radicals, and chelate metal ions [6]. The ring of benzene , the position and

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number of OH group in structure of the phenolic compounds indicate the antioxidant activates as shown in figure 1.

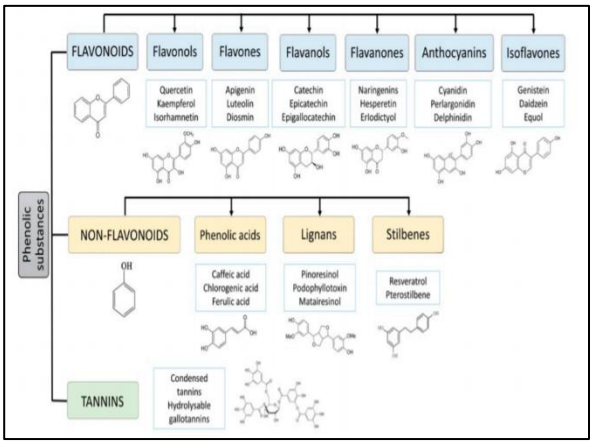

Figure1. Phenols and flavonoids compounds in the plant [7]**.**

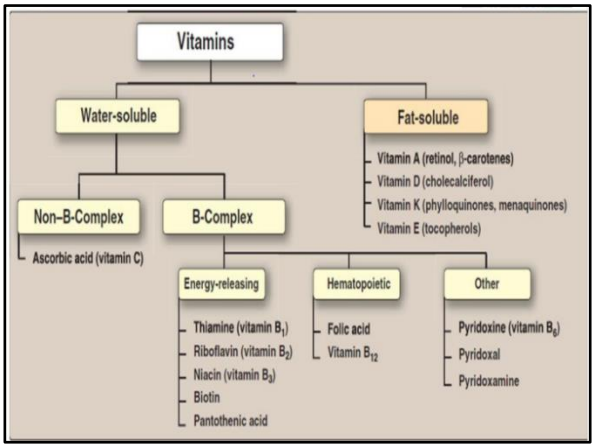

Figure 2. Classification of soluble vitamins

A wide broad of vitamins can be found in cinnamon bark include E, K, C, D, A, and B-complex, which play acritical role in protecting cells against free radical by three mechanisms including: firstly, potentiating enzyme antioxidants .Secondly, Acting as co-enzyme .Thirdly, directly attacking free radical [8].

Vitamins are considered exogenous antioxidants by reducing oxidative stress and protecting the body from a complication of chronic diseases such as DM [9],

Vitamins are essential as regulator of the cellular redox state and contact tightly with complex network synthetic up antioxidant defiance system. In our present investigation, pharmacognostic profile and phytochemical analysis of *Cinnamomum zeylanicum* bark have been evaluated for the presence of bioactive compounds[10].

Experimental:

Cinnamon extract

Preparation of the water extract: Cinnamon bark powder 50 g was soaked with 500 mL distilled water in one litter conical flask (ratio 1:10). Then, the solution was shake for six hours at 37ºC, filtered by (Whatman No.1) filter paper, and the supernatant was concentrated in a rotary evaporator for two hours. Afterwards, the concentrated extract was dried at 40ºC in the oven for two hours, and stored in a dark place at (15ºC)for further experiments[11]. The same procedure was applied for CM ethanolic extract (ratio 1:10) preparation with altering the solvent (ethanol 70%) instead of distilled water[12].

Phytochemical compound

Traditional methods have been used to indicated phytochemical constituents in cinnamon water extract(CMWE)using various chemical reagents as can be seen in (Table 1). The methods included: carbohydrates indicated by Molish test, glycosides indicated by Fehling's test , Dragendroffs test for alkaloids, proteins indicated by Biuret test, saponins by Foam test, steroids indicated by Salkowski test, phenols indicated by $FeCl_3$, flavonoids, and tannins indicated by specific reagents[13].

Determination of Trace elements extract

Minerals content has been quantified based on the official AOAC approach (166) (what is 166). With the use of atomic absorption spectrophotometer (AAS) instrument. The absorbance of each one of the minerals was evaluated at a certain wavelength: Ni (233nm), Se (196 nm), Mo (313.3nm), Co (240nm), Fe (248.3nm), Mn (279.5nm), Zn (213.9nm), V (318.4nm), and Cu (324.8nm). The atomic absorption spectrum was estimated using apparatus NOVAA400 - Atomic absorption spectrometry (Germany). Trace elements were detected and assessed by standard reference methods followed by the Department of Environment and Water, Ministry of Science and Technology.

Vitamins and phenolic analysis using (HPLC)

High performance liquid chromatography was used to estimate vitamins and phenolic compounds in CMWE and CMEE. Standard solution ,which was used for both vitamin as well as phenolic .The quantification have been done via the to the comparison of the sample retention time against standard vitamins and phenolic retention time of recognized concentrations[14].

Table1. Experiment Reagents and Chemical Detection of *C. Zeylanicum* Extracts Active Compounds.

Active Compounds	Experiments Reagents	Indication
Alkaloids	dragendroffs reagent	organ precipitate
Flavonoids	ethanol+KOH	yellow precipitate
Steroids	anhydride sulphuric acid +chloroform	yellow color
Coumarins	sodium hydroxide	yellow-bright green
Phenols	ferric chloride	greenish color
Carbohydrates	molisch reagent	blue cycle
Glycosides	fehling reagent	red precipitate
Proteins	biuret reagent	purple color
Terpenes	ethanol+ sulphuric acid +chloroform+anhydride	brown color
Resins	ethanol+ HCL	white precipitate
Saponions	ferric chloride +shaking extract	foam white
Tannins	lead acetate	white precipitate

Results and Discussion

Phytochemical active compounds

Phytochemical screening of CMWE showed the presence of interesting bioactive compounds including: phenols, alkaloids, flavonoids, carbohydrates, tannins, coumarins, saponin, glycoside, terpenes, and resins, as can be seen in figure (3).

Phytochemicals are considered a novel index to natural therapeutics with antioxidant defence system [15]; phenols protective agent is capable of preventing molecules oxidation by donating a hydrogen atom to free radicals [16]. Flavonoids have attracted a positive effects influencing scavenging lethal radicals and prooxidant properties [17]. Tannins and saponin acts as scavenger agent in cancer and aging as antioxidant protection[18]. Coumarins have neuroprotective and can prevent lipid peroxidation as well as enhancing the same antioxidant enzyme activity in Alzheimer's disease[19]. Terpenes antioxidant activity scavenger (ROS) has a protected role against diabetes and reduces H2O2 and prevents damage to cells[15]. Alkaloid has antimicrobial activity and decreases risk stress[20]. Indicated different phytochemicals in CM extract obtained from dry bark provided cinnamon as an interesting natural source by introducing therapy antioxidant compounds which act through different strategies for preventing or treating numerous diseases[21].

Table2. The concentration of water-soluble and lipid-soluble vitamins in water extracts

Vitamins	CM water extract Reten.Time [Min[	Standard Reten.Time [Min]	Concentration vitamin [Ppm]
Vit. A	9.184	9.345	**27.198**
Vit. E	6.128	6.040	**2.622**
Vit.D_3	7.948	7.890	**1.792**
Vit. K	11.348	11.188	**3.885**
Vit.C	5.152	4.873	**0.354**
Vit. B_1	5.888	6.700	**1.882**
Vit. B_2	6.620	5.793	**1.517**

Atomic absorption Analysis of water extract *C. zeylanicum*

The results obtained by atomic absorption spectroscopy (AAS) analysis of CM water extract in *C.*zeylanicum indicated numbers of important trace elements, they have been clarified in figure (3). These results are agreed with the most current studies[22][23]. The major step in cascade to reach oxidative/antioxidant balance in mammals is increase by the daily portion intake of trace elements in the diet[24].

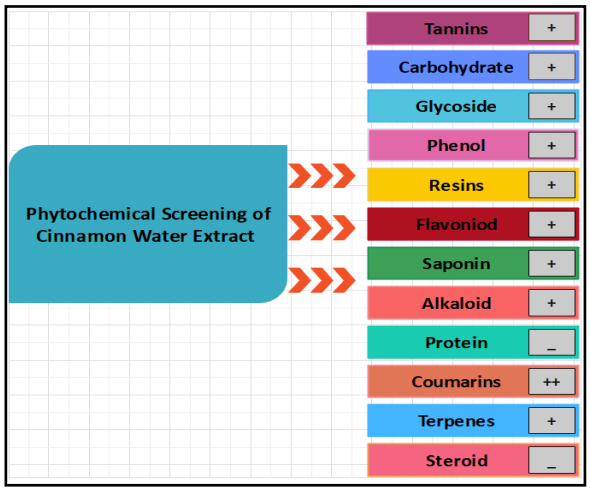

Figure 3. Phytochemical screening of *C. zeylanicum* bark in *C. zeylanicum* barks extract

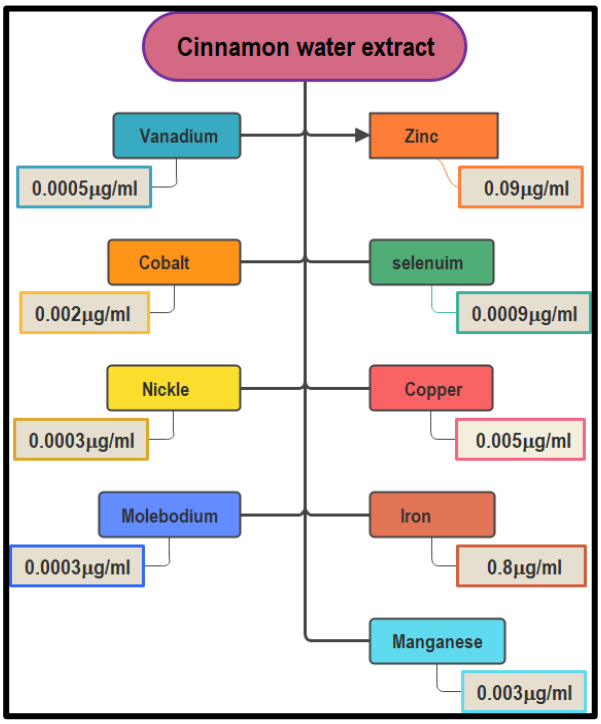

Figure 4. The concentration level of trace elements in *C. zeylanicum* water extract

The results in figure (4) shows the presence of the trace elements (Zn ,Se, Cu, Fe, Mn, Co, V , Ni, and Mo).Trace elements provide many functions involved in growth, development, catalysis enzyme, and redox regulation in biological systems[24]. Also, have a critical role in the antioxidant system by the competition with toxic metals to the stabilization cell membrane and inhibiting fenton reaction [25], also increasing the activation of antioxidant enzyme superoxide dismutase, and glutathione [26]. Studies showed that trace elements including iron, zinc, chromium, manganese, copper, and selenium act as antioxidants and cofactors for many enzymes affecting the metabolism and insulin action[22]. As a result, cinnamon water extract contains a variety of concentration with low dose thus cinnamon can be considered a potent natural antioxidant that could help to reduce diabetic complications.

Vitamins

Vitamins have antioxidant capacity and reduction of these nutrients is connected with complications caused by oxidative stress in different diseases conditions. Results of CMWE with the use of HPLC system. We used three different standards, column C18, and wavelength 245 nm, confirmed the presence of water-soluble vitamin (C) with minimum concentration (0.354 ppm), vitamin (B2 concentration: 1.517 ppm) showed better concentration than vitamin (C). Finley, vitamin (B1 concentration :1.882ppm) which had a higher concentration between the two other vitamins as listed in table (2). CMWE analysis confirmed the presence of lipid-soluble vitamins (A, K, E, D). The results was obtained by comparing with standards with similar column length C18 at the same wavelength nm. On the other hand, retinol (vitamin A gave a 27.198 ppm), while vitamin D appear with a concentration between them. (D: 1.792ppm), and (vitamin K: 3.885ppm). Finely (vitamin E concentration was 2.622ppm). From figure (4) better peak separation was detected during 15min which symmetrical peak with standards[27].Indexed different vitamins in CM extract improve the power athreptic for herb and contribute to inhibiting ROS/RNS effect[8].The resulting table (2), showed the presence of fat-soluble vitamins at the range retention time (5-15min) at wavelength of 230, and 265nm, respectively These results are agreed with the most current study[8]. The active form of vitamins A is retinol present in animals, pro-vitamin A (carotenoid) is found in plants under enzymatic conditions converted to retinol in enterocytes[28]. Retinol antioxidant protection is presented by keeping carbohydrate and lipid metabolism utilized by inhibiting the formation of ROS and reducing oxidative stress[26]. Mechanism

ability presented by scavenging single oxygen and hydroxyl radical as well as prevents LDL oxidation, also protect against some type of cancer and, autoimmune diseases [15]. Vitamin K is naturally classified into three classes: K_1 (Phylloquinone), K_2 (Menaquinone), and K_3 (Menadione). The vital role of vitamin K is to acts as cofactor coagulation blood process and bone synthesis, as well as protection against lipid peroxidation and prevention glutathione depletion to reduce ROS and maintain cells safety [28]. Vitamin D is a potent vitamin in several physiological metabolisms presented in regulated bone metabolism and secretion of parathyroid hormone and defence immunity beside the critical antioxidant roles including inducing lipid peroxidation in the cell membrane and keeping membrane structure, diminishing the ROS formation in a vascular complication that occurs in diabetes and CVD diseases. Significantly vitamin D rise the total antioxidant capacity in a variety of metabolic enzymes [29]. Tocopherol (vitamin E) is naturally found in eight forms including alpha, beta, gamma, delta, portions of tocopherol, and tocotrienol [8]. vitamin E role is represented in breaking fatty acid peroxidation chain reaction and protecting cells from damage, reducing risk complications in diabetes, stimulating the immune system, reducing cardiac cancer, and prevention the development of cardiovascular diseases[26]. The result in table (2), showed the presence of water-soluble vitamins at retention time ranging from 5 to 10 minutes at wavelength 254nm. Ascorbic acid (vitamin C) has a powerful antioxidant role by acting side beside with enzymatic antioxidant to scavenger ROS and blocking damage of vital molecules (nucleic acid, protein, and lipid), as well as taking part as a co-factor in stimulating the immune system, collagen and carnitine syntheses, rising iron absorption, and participate as a strong antioxidant in previous interactions. Pharma research showed that vitamin C can generate ascorbic radical and H_2O_2 therefore, ascorbic acid was used in high doses to damage cancer cells [18]. Vitamin B1 thiaminis an essential vitamin to provide energy from carbohydrate and lipid metabolism as well as the growth of the cell brain and neurotransmission[8]. Also provide antioxidant activity shown by scavenger in superoxide anion and hydroxyl radical [10]. Vitamin B_2 (Riboflavin) in reduced glutathione can dimension hydro peroxide and reduce lipid peroxidation [26]. Many articles referred to the vital effect of vitamins in the diet and improve the exogenous antioxidant ability to reduce the dangers of free radicals in chronic conditions [3][31]. **Phenolic compounds** The HPLC analysis of CMWE and CMEE prepared from cinnamon Ceylon bark, investigated important antioxidant phenolic compounds by C18 column with mobile phase CAN/MeOH (50:50) and wavelength between 210-280 nm. We used eight different standards (phenols) for detection. CMWE results showed interesting concentration for (quercetin: 53.652ppm, cinnamaldehyde: 48.78 ppm, eugenol 19.6 ppm, rutin: 2.498ppm) and with trace concentration (Gallic acid: 0.251ppm, kaempferol:0.391ppm, lignin: 0.787ppm, pyrogallol: 0.860ppm) table (3). In other hand, results for CMEE showed good concentration for (cinnamaldehyde: 74.67ppm, quercetin: 42.687ppm, eugenol: 6.998ppm, lignin: 5.860ppm) and trace phenolic compounds concentration (kaempferol: 0.0122ppm, pyrogallol: 0.014ppm, rutin: 0.0267ppm, gallic acid: 0.030ppm). These compound's structures consist of the ring (one or more) with a hydroxyl group (different in number and position) that influences antioxidant effects on free radicals, these results are agreed with the most current studies [32,33]. Results shown in figure (5) indicated a higher phenolic compounds in both CMWE and CMEE: Cinnmaldehyde primarily between them its active constituent of bark tree cinnamon that flavor, bioactive and order related for this phenylpropanoid compound, enhance defense against ROS contributed hyperglycemia and protect cells by reducing lipid peroxidation[34]. The secondary is Quercetin which have a flavanol structure containing hydroxyl keto group (5-OH plus C=O) that is related the strong ability to prevent metal-induced hydroxyl radical formation [35]. The third is eugenol (4-allyl-2-methoxy phenol) prevents ROS formation under conditions related to cancer, diabetes, inflammation diseases by breaking peroxidation cascade and scavenging radicals [36]. Quaternary Lignin is a polymer antioxidant agent that acts as scavenger free radicals [37]. Gallic acid have (the phenolic hydroxyl group which enable the hydrogen-donor to react with ROS or reactive nitrogen species (RNS) to block the overproduction of damaging free radicals, including peroxyl radicals,

hydroxyl, and superoxide radicals[38]. Rutin has a flavonol structure that provides its ability to scavenger ROS, also stimulate expression of CAT and SOD antioxidant enzymes, thus investigating potent antidiabetic and anticancer [39]. Kaempferol has an antioxidant protection related to its ability to donate electrons and increase the antioxidant capacity of glutathione thus preventing the risk of oxidative stress in atherosclerosis and diabetes complications[32]. Pyrogallol (1,2,3-trihydroxybenzene) is a polyphenol that can be affected as an oxygen scavenger, thus reducing oxidative stress[40].

Table 3. The concentration of phenolic compounds content in C. zeylanicum bark extract

Phenolic compounds	Result in CMWE		Result in CMEE	
	Area[mV.s]	conc.[ppm]	Area[mV.s]	conc.[ppm]
Cinnmaldehyde	1642.025	**48.78**	2513.525	**74.67**
eugenol	7898.999	**19.6**	2819.941	**6.998**
Gallic acid	2286.614	**0.251**	276.857	**0.030**
Rutin	1814.709	**2.498**	19.432	**0.0267**
kaempferol	1065.025	**0.391**	33.065	**0.0122**
Quercetin	7174.045	**53.652**	5707.793	**42.687**
lignan	829.193	**0.787**	6174.452	**5.860**
pyrogallol	7382.256	**0.860**	128.409	**0.014**

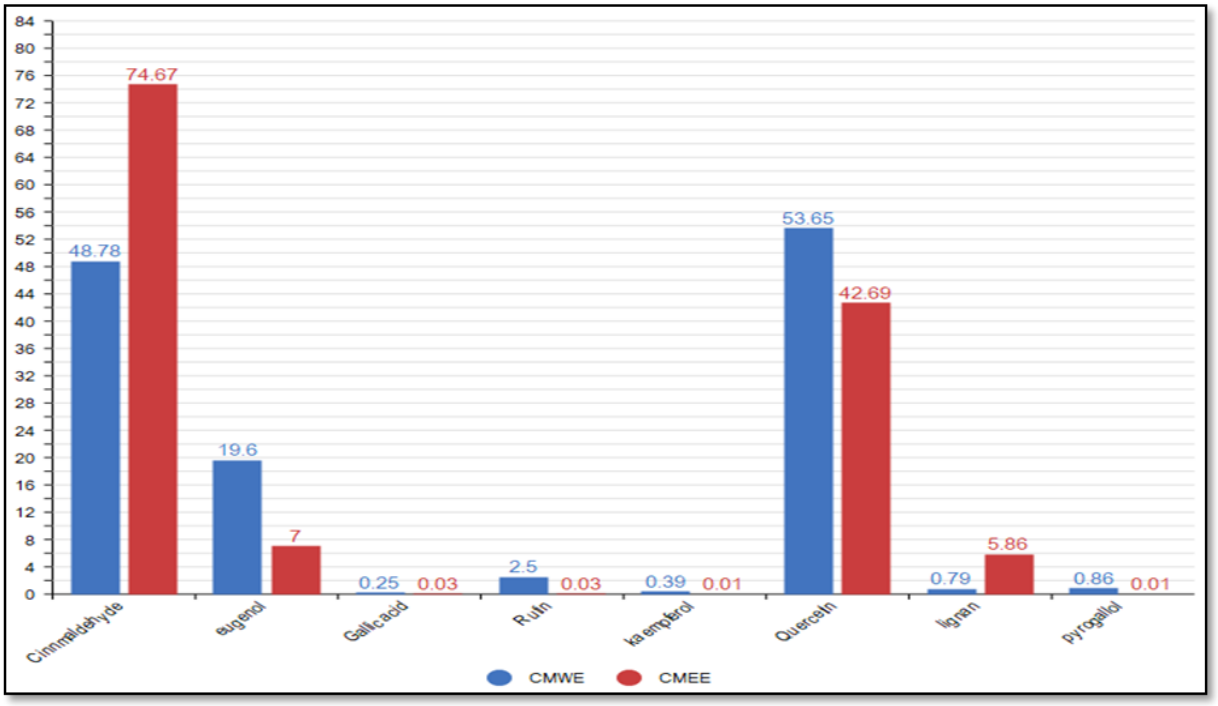

Figure 5. The concentration of phenolic compounds content in CMWE and CMEE

Conclusion

Extract of cinnamon bark have various phytochemical secondary metabolites may be responsible for the observed antioxidant activity. In addition, the extract contains potent phenolic antioxidant compounds and vitamins that gave the importance of cinnamon bark extract as acritical scavenger free radicals that mediate metabolic chronic disease. Daily diet of cinnamon can bring health to people and further research should focus on the development of an appropriate form and route of administration of cinnamon so that therapeutic effects are maximized.

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