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Effect of cumin and coriander seeds consumption on dyslipidemia, abdominal fat, body weight, and lipid profile in rat models

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Abstract

Dyslipidemia is considered a crucial risk factor for high risk of atherosclerosis and cardiovascular diseases. Cumin and coriander seeds are well-known flavoring agents that contain nutraceutical properties and appear to have beneficial health effects. A study was therefore conducted to investigate the effects of cumin and coriander seeds on body weight, abdominal fat and lipid profile in rats. For this purpose, 18 male albino rats were fed on fat-rich diet (diet A) for 14 days, followed by the control diet mixed separately with 20 g of cumin (diet B) and 20g of coriander (diet C) for the next 4 weeks. The body weights and lipid profiles of the rats were analyzed at the start of the intervention and thereafter weekly. Results showed that cumin seeds help to reduce body weight, ranging from 178g to 141g (37g), even for a short time. Post-mortem examination revealed that rats fed cumin diet have less fat accumulation in abdominal cavity compared to control and coriander seeds diets. Elevated values of high-density lipoprotein (HDL) were observed particularly from day 14 to 35 in rats fed with both cumin (from 72.3 to 88.0 mg/dl) and coriander seeds, (from 63.2 to 88.0 mg/dl) as compared to control group (55.0 mg/dl) (P>0.05). Also, a remarkable reduction of low-density lipoprotein (LDL) and total lipid profile was seen in cumin group, as compared to the controls. This interventional study reported that cumin seeds helped in the significant reduction of weight, abdominal fat and total lipid profile while increasing the HDL in rats.

Keywords: Cumin seeds, Coriander seeds, Dyslipidemia, HDL, LDL.

1. Introduction

Dyslipidemia appears to be a major cause of atherosclerosis, while hyperlipidemia (higher levels of cholesterol) is considered as another crucial risk factor for an increased risk of cardiovascular diseases. Dyslipidemia is characterized by high levels of low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), high triglycerides and low levels of high-density lipoproteins (HDL). The major components of serum total cholesterol (TC) i.e., LDL and VLDL act as transporters of cholesterol to peripheral tissues, leading to the incidence of atherosclerosis [1].

Since drug therapy has shown promising results in regulating cholesterol levels. Different strategies focused on the development of the drugs, supplements, diets and lifestyle adjustments to reduce the serum TC, LDL and VLDL levels for prevention of atherosclerosis [2]. Preliminary trials and experiments on most of these strategies are largely performed on laboratory animals, especially rats. The rats have shown several advantages and are an ideal approximate model for the study of different diseases [3]. Concomitant albino rats have long been widely used due to their small size, ease to acquisition and versatility in application for experimental studies evaluating the effects of different drugs and therapies on atherosclerosis [2, 4]. However, high cost and several side effects of lipid-lowering drugs have now diverted the researcher's attention to find natural drugs made up from natural compounds, relatively safe and easily available at affordable prices [5].

Considering that, spices are used in almost all cultures and societies to enhance the taste and color of the food. Apart from their sensory attributes, spices and herbs possess nutraceutical properties and exhibit antimicrobial,

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antioxidant, and medicinal effects [6, 7]. Different studies have identified that spice-derived nutraceuticals are helpful against many physiological disorders, including diabetes, cardiovascular disease, and cancer [8–10]. Similarly, commonly used spices such as cumin seed, being a rich source of antibacterial, antifungal and antioxidant components, can be used as potent agents in food preservation and therapeutic industries [11].

Cumin (Cuminum cyminum) seed is a frequently used popular seasoning spice, also used in various native curative functions. It belongs to the family "Apaiaceae" and appears to have tremendous functional properties as a traditional therapy around the world. Also, several macro and micronutrients, tannins, phytic acid, fiber constituents, polyacetylenic compounds, as well as nonspecific fat-transmitting protein have been found in cumin seeds [12]. The chemical composition of cumin extracted oil have been identified with almost 21 active components, including cuminaldehyde (4-isopropylbenzaldehyde), showing advanced antifungal and antioxidant activities [13]. Also, the cumin inhibitory effect of two enzymes of a-glycosidase and adlose reductase in the metabolic pathway of carbohydrate digestion appears to improve glycemic indices and exhibit anti-diabetic effects [14]. Furthermore, the cumin seeds help to aid digestion, showing the stimulatory effect on the digestive enzymes while increasing the activity of pancreatic trypsin, chymotrypsin, and amylase [15]

In concomitant, coriander (coriandrum sativum) also belongs to the same family "Apiaceae" found in the ancient Egyptians records and was used in food preparation, stomach disturbance and diarrhea. Previous studies on coriander seeds have demonstrated hypoglycemic effect in vitro [16] and hypolipidemic effect in animals [17]. Coriander also suggested recovering digestive problems, improving craving, loss of memory, anxiety and for its antimicrobial action [18]. It is helpful to stimulate gastric acid emission by a cholinergic mechanism [10]. The chemical composition has reported the presence of polyphenols (caffeic acid, caffeic acid derivatives, ferulic acid, cholorogenic acid and galic acid), carotenoids (mainly β-carotenoids) and flavonoids (quercetin and isoquercetin) in coriander seeds, showing pronounced antibacterial and antifungal properties [18].

Cumin and coriander are commonly used spices in Pakistan and some research has been conducted in the country to evaluate the nutritional value and biological activities of cumin and coriander seeds [12]. However, the role of these nutraceuticals warrants further exploration to ensure their medicinal use more than their flavoring properties. Furthermore, previous studies have observed controversial effects of cumin supplementation in overweight, prediabetic, dyslipidemic, and T2DM patients [14, 19, 20]. Cumin and coriander seeds are commonly used spices in Pakistan. More studies are needed to determine the economic implications and its use in reducing the risk of obesity. Therefore, the present study was conducted to investigate the role of cumin and coriander seeds on dyslipidemia, abdominal fat, body weight and lipid profile in clinically healthy albino rats.

2. Materials and Methods

2.1. Experimental animals

The study was conducted at the University of Veterinary and Animal Sciences, Lahore. The adult male albino rats (n = 18) of almost same age and weight were divided randomly into three units containing 6 rats in each group. They were housed in individual metal cages with free access to feed and water. Their body weights were recorded initially on day one and weekly thereafter. The temperature was maintained at 25±37°C with 12/12 hours' light and dark periods.

The study was approved by the ethical review committee, University of Veterinary and Animal Sciences, Lahore (Reference no. DR/1109). All the animals were managed according to international standards and husbandry practices.

2.2. Experimental diet

A basal diet was prepared with 64.5 g broiler grower ration, 20 g fat (dalda ghee) and 15.5 g skim milk per 100 g. Sufficient water was added to make the diet into cakes. The cakes were dried in the oven for 24 hours at 80 ˚C. This basal diet was designated as diet A, while diet B and C included 20 g/kg of cumin and coriander seeds, respectively. For this purpose, seeds of cumin and coriander were procured from the local market of Lahore, Pakistan, cleaned and powdered to pass through a 50-mesh sieve.

2.3. Proximate analysis

Before feeding rats, basic composition of all three types of diets was analyzed (Table 1). These seeds were analyzed for proximate composition (AOAC) to determine the inherent nutritional potential and used to prepare experimental diets [21].

Basal diet served as control (A diet) and was fed to all three animal groups for initial 14 days. After 14 days of feeding basal diet, the 18 rats were randomly divided into three groups, 6 in each group. Group A (control group) fed on the same basal diet while experimental group B (cumin group) were fed on diets B containing 20 g/kg cumin seeds and experimental group C (coriander group) were fed on diet C with 20 g/kg on coriander seeds, respectively for next four weeks. The body weights of all the rats were recorded at weekly intervals. Blood samples were collected from rats of each group and were analyzed weekly for lipid profile.

2.4. Analysis of lipid profile

The body weight of all rats was monitored at the start and then weekly thereafter. Blood samples were collected at the start of experiment and there after weekly by selecting one rat from each unit randomly under anesthetized condition by heart puncture. The samples were analyzed for total lipid profile by spectrophotometric method using the commercially available kits [22] for the analysis of total lipids, cholesterol, serum triglycerides were estimated by commercially available kits (Randox, UK), based on GPO-PAP method [23], LDL based on method established by [24] and HDL by precipitant method.

2.5. Statistical analysis

The effect of different diets (basal, cumin and coriander seeds) on body weight, LDL, HDL, triglycerides, VLDL and total lipid profile was compared using Analysis of Variance (ANOVA). Body weight on day 14 was taken as co-variate for body weight analysis on days 21, 28, 35 and 42. The replicate cages were treated as experimental units and the position of cages was used as block. Values were considered significant if P ≤ 0.05. In case of significant differences, the Duncan multiple range test was employed to compare differences among means. All statistical procedures were performed using Genstat 11 for Windows (VSN International Ltd, Hemel Hempstead, UK).

2.6. Post-mortem examination

At the end of experiment, clinical examination of principal organs was performed for post-mortem examination.

3. Results

The experiment was conducted to see the effect of two commonly used spices (cumin and coriander) on growth and lipid profile in albino rats (Tables 2-7).

3.1. Proximate analysis

Basic composition of all three diets was almost similar (Table 1). The proximate analysis of diets showed that diet A contained 3.40 % moisture and diets B and C contained 2.40 % moisture by drying 2 g of representative sample in an oven. In control diet, crude protein was 16.61 % whereas in diets B and C, it was 16.06 % and 17.05 %, respectively. Crude fiber was high in cumin diet (6.00%) compared to control diet (4.30%) and coriander diet (5.50). Proximate analysis of diets did not show any difference in all the parameters measured (Table 1).

3.2. Body weight and abdominal fat

In the present study, rats in fed cumin group had higher body weight at initial days 21 and 28th compared to rats fed control diet. However, when observed over the days, supplementation of cumin seeds resulted in the significant reduction of body weight from 178g to 141g (37g) as compared to control (14g) during days 21 to 42. However, no remarkable difference was observed during days 21 to 42 regarding the effect of coriander seeds on weight changes in albino rats (Table 2).

Table 1. Proximate analysis of different diets.

	Diet A	Diet B	Diet C
Dry matter (%)	96.60	97.60	97.60
Moisture (%)	3.40	2.40	2.40
Crude protein (%)	16.61	16.06	17.05
Crude fibre (%)	4.30	6.00	5.50
Ether extract (%)	24.40	28.1	25.50
Ash (%)	5.00	4.80	5.40

* = Significant (P-value < 0.05), Diet A (Control group), Diet B (Cumin seeds), Diet C (Coriander seeds) after applying SEM.

3.3. Abdominal histology

Post-mortem examination was done at the end of experimental period to observe accumulation of body fat lesions in different organs of rats fed different diets. Anatomopathological post-mortem examination did not reveal any pathology that could be specifically attributed to nutritional imbalance, confirming the suitability of experimental diets (basal, cumin and coriander seeds) for rat growth. As far as fat accumulation in the body of rats of different groups was concerned, rats fed cumin seed diets had less abdominal fat as compared to the rats fed on control diet (Figure 1 a and b). No difference was observed when comparing cumin seeds to coriander seeds group. Necropsy examination of principal organs (liver, lungs, kidneys and heart) did not reveal any difference between rats of different experimental groups.

3.3. Low-Density Lipoprotein (LDL)

The amount of LDL in rats fed experimental diets is presented in Table 3. On day 21, rats fed cumin seeds had higher LDL (p=0.005). However, rats fed cumin seeds had significantly lower LDL (P<0.05) when compared with the control and coriander groups on day 28. Later, during days 35 to 42, values of LDL were not significantly affected (P>0.05) by dietary inclusion of cumin and coriander seeds (Table 3).

3.4. Very Low-Density Lipoprotein (VLDL)

The concentration of VLDL in rats of different groups is presented in Table 4. Supplementation of cumin and coriander seeds did not have any effect (P>0.05) on VLDL from day 14 to 42 as compared to control group.

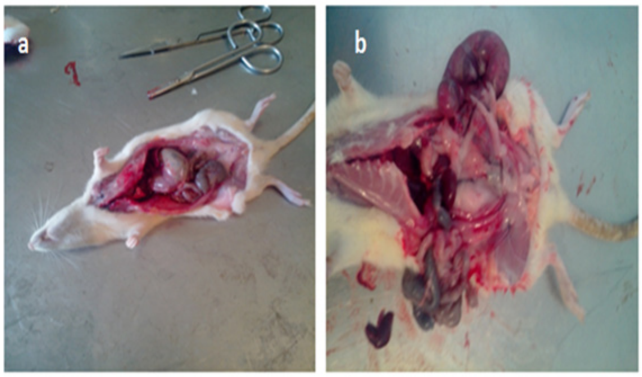

Fig. 1. Postmortem examination of male albino rats. (a) rats from group fed cumin diet showing less abdominal fat (b) rats from control group showing more accumulation of abdominal fat.

Table 2. Body weight (g) of rats fed control, coriander, and cumin seed diets on different experimental days (Day 14-42).

Parameters	Day 14	Day 21	Day 28	Day 35	Day 42
Coriander group	124.5^{a}	125.5^{a}	137^{b}	132.0^{a}	132.0^{a}
Cumin group	175.9^{c}	178.0^{c}	157^{a}	149.0^{b}	141.0^{ab}
Control group	150.8^{b}	154.5^{b}	144^{b}	149.5^{b}	148.8^{b}
Probability of difference	<.001	<.001	0.005	<.001	0.003
SEM[1]	1.32	1.36	2.67	1.85	1.95

Data represent the mean of 6 rats per treatment. Means within a column without common superscript differ significantly (P<0.05). [1]SEM: Standard error of means.

Table 3. Amount of Low-Density Lipoprotein (LDL) (mg/dL) of rats fed control, coriander cumin seed diets on different experimental days (Day 14-42).

Parameters	Day 14	Day 21	Day 28	Day 35	Day 42
Coriander group	38.4	35.6	51.8[a]	52.4	51.0
Cumin group	43.1	68.0[a]	42.0[ab]	49.0	45.0
Control group	45.3	47.6	59.0[b]	45.0	49.0
Probability of treatment effect	0.767	0.005	0.042	0.749	0.859
SEM[1]	5.67	4.23	3.60	6.73	7.79

Means within a column without common superscript differ significantly (P<0.05). [1]SEM: Standard error of means.

Table 4. Concentration of Very Low-Density Lipoprotein (VLDL) (mg/dL) in rats (Day 14-42) fed control, coriander, cumin seed diets.

Parameters	Day 14	Day 21	Day 28	Day 35	Day 42
Coriander group	24.8	26.3	47.2	41.0	54.4
Cumin group	25.6	27.2	44.4	39.4	50.8
Control group	22.8	25.1	49.9	42.0	50.8
Probability of treatment effect	0.896	0.978	0.924	0.976	0.962
SEM[1]	6.98	7.12	9.75	8.38	10.56

[1]SEM: Standard error of means.

Table 5. Concentration of High-Density Lipoprotein (HDL) (mg/dL) in rats (Day 14-42) fed control, coriander, cumin seed diets.

Parameters	Day 14	Day 21	Day 28	Day 35	Day 42
Coriander	63.2	65.4	69.3[b]	88.0[b]	64.0[a]
Cumin	72.3	72.6	69.0[b]	88.0[b]	54.4[a]
Control	65.0	67.0	57.0[a]	55.0[a]	42.0[b]
Probability of treatment effect	0.787	0.878	0.003	<.001	<.001
SEM[1]	1.86	1.77	1.74	1.99	2.19

Means within a column without common superscript differ significantly (P<0.05). [1]SEM: Standard error of means.

Table 6. Concentration of triglycerides (mg/dL) in rats (Day 14-42) fed control, coriander cumin seed diets

Parameters	Day 14	Day 21	Day 28	Day 35	Day 42
Coriander	128.0	131.0	236.0	205.0	272.0
Cumin	143.8	135.7	222.4	197.0	254.0
Control	124.6	125.6	249.6	210.1	254.0
Probability of treatment effect	0.676	0.577	0.414	0.858	0.596
SEM[1]	5.78	6.49	13.44	16.65	13.84

[1]SEM: Standard error of means.

Table 7. Concentration of total lipids (mg/dL) in rats (Day 14- 42) fed control, coriander cumin seed diets.

Parameters	Day 14	Day 21	Day 28	Day 35	Day 42
Coriander	248.9	257.7[a]	404.3[ab]	386.4[b]	431.4[b]
Cumin	252.8	303.5[b]	368.8[a]	357.4[a]	385.2[a]
Control	254.9	265.3[a]	415.4[b]	351.6[a]	446.2[b]
Probability of treatment effect	0.781	0.002	0.015	0.013	<.001
SEM[1]	7.88	7.84	11.36	8.42	8.21

Means within a column without common superscript differ significantly (P<0.05).[1]SEM: Standard error of means

3.5. High Density Lipoprotein (HDL)

The concentration of HDL in three different groups of rats fed experimental diets during days 14-42 is shown in Table 5. Supplementation of both cumin and coriander in diet resulted in higher values of HDL (P<0.05) along the experiment days and as compared to control group of albino rats.

3.6. Triglycerides

Levels of triglycerides in blood of rats fed control, cumin and coriander-supplemented diets are shown in Table 6. Supplementation of cumin and coriander in diet did not have any effect on triglyceride values in rats at any of the sampling days.

3.7. Total Lipid Concentration

Total lipid concentration in blood of rats fed control, cumin and coriander seed-supplemented diets is presented in Table 7. Supplementation of cumin seeds resulted in lower values of total lipids (P<0.05) during days 28 to 42 as compared to coriander group and control group.

4. Discussion

The experiment was conducted to see the effect of two commonly used spices (cumin and coriander) on weight, abdominal fat and lipid profile in albino rats when compared with the control group. Basic composition of all three diets was almost similar. The only difference in these diets was the presence of cumin and coriander seeds in diet 'B' and diet 'C', respectively.

Hyperlipidemia is the major cause of non-communicable diseases, including diabetes, reduced thyroid levels, cardiovascular malfunctioning, and coronary heart disease [25]. In our study, rats fed cumin group had higher (P<0.001) body weight at the beginning of the experiment; however, when observed over the days, supplementation of cumin seeds resulted in greater weight reduction as compared to control and coriander groups. These results are in agreement with the previous study of Taghizadeh *et al.,* who reported a significant decrease in weight through administration of cumin seeds among overweight subjects [19]. However, no significant weight reduction was observed in our study in rats fed with coriander seeds, contradict to Guler study which showed higher weight gain in Japanese quails receiving diet containing 2% coriander seeds [26]. The reason for this difference in results may be due to improvement in feed intake in quails fed 2% coriander seed diet, whereas in our study, rats were fed with an equal amount of diet (1 dry cake/day). Regarding the effect of cumin seeds, anti-obesity effect of cumin seeds has been reported previously by enhancing the production of leptin in rats, an adipocyte hormone that functions as the afferent signal in negative feedback and therefore may affect the reduction of weight [27].

Considering the LDL values, our study reported that rats fed cumin seeds had higher LDL (P>0.05) on day 21. However, on day 28, rats fed cumin seeds had lower LDL (P<0.05) when compared to the control. During days 35 to 42, values of LDL were not affected (P>0.05) by dietary inclusion of cumin and coriander seeds. In agreement with our study findings, Aissaoui *et al.,* in 2011, showed that the administration of cumin seeds resulted in reduction in LDL levels in hyperglycemic and hyperlipidemic rats through the use of the dried aqueous extract of cumin seeds [9]. Similarly, a previous study showed improvement in lipid metabolism and reduction in the levels of LDL and VLDL in rats following inclusion of coriander seeds [17]. The concentration of VLDL in rats of different groups was found to be that supplementation of cumin and coriander seeds did not have any effect (P>0.05) on VLDL. Similarly, supplementation of cumin and coriander seeds in diet did not have any effect on triglyceride values in rats at any of the sampling days. Our results are similar to the findings of Morovati et al., who reported no improvement in lipid profile through the supplementation of cumin essential oil in patients with metabolic syndrome [28].

Regarding total lipid concentration, supplementation of cumin seeds resulted in lower values of total lipids (P<0.05) during days 28 to 42. Cumin seeds, being a nutraceutical, possesses anti-inflammatory and antioxidative properties that help to reduce LDL oxidation, proinflammatory gene expression, monocyte migration, foam cell formation, and plaque stability [29]. Also, coriander seeds are rich in phytochemical components and polyphenolic-rich fractions of coriander facilitate improving lipid profile [30].

Concentration of HDL in three different groups of rats fed experimental diets during days 14-42 showed that supplementation of cumin and coriander in diet resulted in higher values of HDL (P<0.05) in rats. These results are similar to the previous findings of Zare and colleagues [17, 31]. It has been anticipated that oxidized form of LDL is responsible for cellular uptake to form macrophages derived from cells responsible for early development of atherosclerosis. Oxidized LDL is believed to play a potent inflammatory mediator role along with endothelial damage, leading to atherogenesis [32]. Also, myocardial infarction, vastly prevailing ischemic state caused due to tissue necrosis buildup due to the lack of balance in oxygen requirement and provision and ultimately results in cardiovascular impediment [33].

Lipids are commonly evaluated in the blood/serum of humans and animals due to their clinical significance for cardiovascular disease risks and health outcomes. In this regard, cholesterol, being an important component of mammalian cell membranes, performs a major role in membrane permeability and fluidity. It also serves as a precursor of bile acids, steroid hormones and fat-soluble vitamins. Cholesterol is transported in the bloodstream in association with different lipoproteins named on the basis of their density, such as HDL, LDL, VLDL [34]. The major components of serum TC are associated with increased risk of atherosclerosis. In this regard, LDLC and VLDLC play the major physiological role in increasing the risks, while HDLC mobilizes cholesterol from developing and existing atheromas and transports it to the liver for excretion in bile [35].

Medicinal plants are considered to be a viable alternative to synthetic drugs for treatment of different disorders, including lowering lipid profile. Cumin, as one of these medicinal plants, contains more than 100 different chemicals, essential fatty acids, carvone, limonene and flavonoids and is believed to reduce lipid levels through antioxidant properties of Quercetin (flavonoids) and carvone [20]. In concomitant, flavonoids and polyphenols present in coriander seeds are known to be responsible for hypoglycemic and hypolipemic effects of coriander seed s[9].

Post-mortem examination was done at the end of experimental period to observe accumulation of body fat lesions in different organs that fed different diets. Anatomopathological post-mortem examination did not reveal any pathology that could be specifically attributed to nutritional imbalance, confirming the suitability of experimental diets (basal, cumin and coriander seeds) for rat growth. As far as fat accumulation in the bodies of rats of different groups was concerned, rats fed control diet had more fat accumulation in abdominal cavity compared to rats fed cumin and coriander seed diets. Necropsy examination of principal organs (liver, lungs, kidneys and heart) did not reveal any difference between rats of different experimental groups.

Yet this is a comprehensive preliminary study evaluating the beneficial effects of cumin and coriander seeds to reduce the risk of cardiovascular diseases; however, our study has few limitations. We have used only male albino rats due to limited availability; however, previous studies have found significant variations in the serum lipid profile of albino rats across the sexes at certain ages [4]. Similarly, our findings were based on a brief interventional trial. Further studies are needed for long-term effects and the future implications of these cost-effective natural compounds.

It is concluded from this preliminary trial that feeding cumin seeds can help to reduce weight and abdominal fat even for a short time. This interventional study also resulted in remarkable reduction in LDL and total lipid profile, with significant increase in HDL of experimental rats fed with cumin seed diet when compared against control group.

The results could be helpful to decrease hyperglycemia as well as reduce complications caused by dyslipidemia; however, less significant results were reported for rats fed on coriander seed. Future work is necessary to determine economic implications and its use in reducing abdominal fat.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Consent for publications

All the authors have read and approved the final manuscript for publication.

Ethical approval

The approval of the study was taken from the ERC (Ethical Review Committee) of the University of Veterinary & Animal Sciences, Lahore (Reference no. DR/1109).

Author contributions

Sehar Iqbal:.Conceptualization, Literature Search, Data Collection, Writing Original Draft; Rida Fatima Saeed: Conceptualization, Review & Editing; Saira Zafar: Data Collection, Final Proofreading; Asma Saleem Qazi: Conceptualization, Data Analysis; Syed Hassan Bin Usman Shah: Conceptualization, Data Analysis; Juweria Abid: Data Collection; Data Analysis; Umar Farooq: Review & Editing; Sajeela Akram: Literature Search, Review & Editing; Abdul Momin Rizwan Ahmad: Review & Editing

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