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Original Research Article

Exploring the diuretic activity of Bisehri booti (*Aerva lanata*): an efficacious medication for nephrological disorders.

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ABSTRACT

Aim and Objective: The Bisehri booti (*Aerva lanata*) is an effective traditional medicine used for the treatment of nephrological disorders. This study aimed to investigate the diuretic activity of Bisehri booti by measuring urinary volume and sodium in albino rats.

Methods: Four groups of five animals each were administered normal saline, hydrochlorothiazide, aqueous extract of Bisehri booti, and juice of Bisehri booti, respectively. Urine volume and sodium concentrations were measured to evaluate the diuretic activity of Bisehri booti.

Results: Urine volume and sodium concentrations were significantly increased in the hydrochlorothiazide group and the groups administered with aqueous extract and juice of Bisehri booti, compared to the control group. The study showed that Bisehri booti has moderate diuretic activity, with the juice being more active than the extract. The finding was at variance with the demonstration of steroidal activity in the test drug in the present study. However, it is possible that the test plant possesses two or more active principles having steroidal and diuretic activity, respectively, making it a better drug for renal ailments as it would exert steroidal activity without the water and sodium retention, which is an undesired effect of steroidal drugs.

Conclusion: The study provides scientific evidence supporting the traditional use of Bisehri booti as a diuretic agent. Further studies are needed to identify the active principles responsible for the observed diuretic activity and to investigate the potential of Bisehri booti in the treatment of renal ailments.

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INTRODUCTION

The practice of employing folk drugs or ethnic drugs is generally perceived as encompassing the use of drugs among tribal and rural communities as well as those utilized in traditional systems of medicine such as Tibb-e-Unani and Ayurveda, as these drugs are derived from herbs. However, this viewpoint is inadequate because Tibb-e-Unani and other traditional systems of medicine are complex systems with a systematic pharmacology based on comprehensive physiology and pathology, which cannot be equated with unspecialized, incomplete, and unorganized drug information common among forest-dwelling and rural communities, just because most traditional medicine drugs are derived from herbs. Some drugs are borderline in that they are widely used among rural communities but receive only sporadic mention in traditional medicine texts. Scientific research on such drugs could not only identify valuable agents but also improve traditional systems of medicine by shifting peripheral drugs to the mainstream. Bisehri Booti

(Aerva lanata) is frequently used by rural communities in India and Sri Lanka, but only a few Tibb-e-Unani physicians mention it [1]. It is used as a diuretic and anthelmintic agent and is employed to treat ailments like headaches, diarrhea, sore throat, and coughs [2-4]. A few Unani physicians have found it to be useful in treating conditions like albuminuria, haematuria, renal and vesicular calculi, and prostatitis, but its most important medicinal use appears to be in conditions similar to nephrotic syndrome [5-6]. Bisehri Booti was tested for its anti-inflammatory, analgesic, steroidal, diuretic, and anthelmintic activity, as it is also used by common people to treat headaches and worm infestations [7]. Udupihille et al. (1986) conducted a systematic study on various parts of the plant to determine their diuretic activity, and they found that the fresh flowers of the plant have the strongest diuretic activity. According to reports from experimental studies, the plant produces a hypotensive effect, but there are conflicting reports about its cardiac effect, and it is claimed to have negative chronotropic and extra systole at a dose level of 50 mg/kg. In the hypodynamic frog heart preparation, a level of 1-3 mg/ml of perfusion fluid, the plant produced a positive inotropic effect, as reported by Tripathi et al. (1990) [8-9].

In the light of above considerations Bisehri booti (*A. lanata*) was tested for its diuretic and activity which is done by the Measurement of Urinary Volume and Sodium in albino rats. Since the Unani physician use the Juice of whole plant, therefore, it was used in the present study also. There are obvious difficulties in the use of the Juice of the plant, therefore, the aqueous extract of the whole plant was also studied with the view of comparing its effect with the Juice and thereby identifying the extract as a more convenient formulation if it was found to be equipotent with the Juice. The Unani clinical dose of Bisehri booti (*A. lanata*) In 20 mg / kg of the Juice it was converted into the corresponding rat dose by multiplication with 7. [10] The value thus obtained was rounded of to 15 mg / 100 g of Juice and this was used a one of the doses in study. It la widely felt that the doses reported in Unani texts are generally on the lower side and this is one of the reasons for the failure of therapy with these drugs, therefore, a slightly higher dose that is 20 mg / 100 g of the juice was also studied. The aqueous extract yield was 1/10th of the crude drug W/W. Since the juice yield is also nearly of the same order W/W, therefore, the aqueous extract of Bisehri Booti (*A. lanata*) was also studied at the same doses as that of the juice 15 mg / 100g and 20 mg /100 g in albino rats.

Aerva lanata is a perennial, herbaceous weed that groweth in a suberect diffuse or prostrate to erect manner. It is frequently found in waste lands as well as crop fields, spanning throughout the tropical regions of Asia and Africa [1, 12]. In India, it is distributed widely in hotter regions reaching an altitude of up to 900 meters on hills, as well as the plains of Bengal, extending westward to Konkan, Madhya Pradesh, and also present in the Punjab and trai region of UP [13, 14]. The plant is also commonly located in the Philippine region [15, 16], and distributed in Arabia, Tropical Africa, and Java [7]. The season of its flowering spanneth from the months of October to November, and continued until June [1, 17].

The plant is usually pubescent or villous and can grow to a height of 1-4 feet, with a base that is often woody. In old plants, branches grow longer and arise from either the stem or the root stock [1, 18].

In microscopic view, the hairs of the plant are arranged in a single row. The epidermis is made up of a single layer with a thin cuticle, which is more pronounced at the ridges. The epidermal cells are square-shaped, thin-walled, and lacking in lignin. The cells in the ridges are thicker-walled. The trichomes are elongated and composed of interlocking cells, which are thick and have pointed outgrowths. The basal cells of trichomes have yellow walls. The cortex is composed of isodiametric parenchyma with intracellular spaces and is 5-7 cells deep in the furrows. The primary vascular bundles in the young stem are numerous, small, collateral and open within inner phloem arranged in a ring typical of dicot stem. The stem shows secondary growth, which becomes abnormal later due to the production of conjunctive tissue, wherein phloem and xylem elements are embedded. The anamalous secondary growth of typical Amaranthus type is very clear. In the old stem, four rings of secondary tissues are found. The pith is larger in the young stem composed of thin-walled parenchyma and reduced in old stem due to increase in the amount of second xylem. Prismatic calcium oxalate crystals are also found in this region. The epidermal cells of the leaf are irregular in shape and have anomocytic type of stomata. The leaf has more trichomes than the stem, which have the same structure as those in the stem. The transparent prismatic nature of calcium oxalate crystals is also found in the leaf, but in lesser numbers [6, 19, 20].

The plant *A. lanata* has been studied for its chemical composition, revealing the presence of several compounds including Beta-sitosteryle palmitate, Alpha-amyrin, and Beta-sitosterol [21]. In addition, inorganic salts, free sugars, tannins, flavonoids, and hexaeosinol have also been identified [22]. Further research by Chandra in 1990 resulted in the isolation of new

constituents including hentriacontane, Beta-sitosterol, Alpha-amyrin, and botulin [23]. In 1991, four flavonoids, two feruloylamides, and other phenolic compounds were also isolated and their structures identified [24]. Six alkaloids were also discovered, including two previously known ones, Canthin-6-one and Beta-corbolin-1-propionic acid, and four new ones: 10-methoxy-canthin-6-one, 10-hydroxy canthin-6-one, 10-0- ß D-glucopyrano syloxycanthine-6-one, and 6-methoxy-ß-corbolin-1-propionic acid [5].

The aforementioned alkaloids, excluding the second and sixth ones, were obtained from the roots of the same plant using similar methods. The first four alkaloids were isolated from the chloroform extract, whereas the fifth and sixth ones were obtained from the ethyl acetate extract. The plant tested positive for cellulose, lignin, sterol, cutin, subrin, protein, tannin, and saponin, while starch and fat were not present. The petroleum extract of the dried plant contained terpenes, alkaloids, and phytosterol, which were likely beta-sitosterol, stigmasterol, and two compounds identified as possibly kaempferol-3-galactoside, and kaempferol-3-rhamnogalactoside and kaempferol. The free sugars detected in this plant were fructose, galactose, sucrose, and rhamnose [6, 19].

FTIR analysis of the different parts of the plant, namely the roots, stems, leaves, and flowers, showed the presence of several functional groups like amides, alcohols, carboxylic acids, nitro compounds, amines, and alkyl halides. The leaves of the plant are rich in minerals such as K, Na, Ca, Mg, Zn, Fe, and Mn, while the entire plant contains essential trace elements such as calcium, silicon, magnesium, potassium, chloride, carbon, and oxygen. Gallic acid is present in significant quantities in the roots, and the roots extract also contains quinones, phenols, triterpenoids, phytosterols, and phlobatannins. The stem's aqueous extract revealed the presence of gallic acid, apigenin-7-O-glucoside, quercetin-3-O-rutinoside, and myricetin upon phytochemical screening. The GC-MS analysis of different parts of the plant such as leaves, stems, roots, flowers, and seeds showed the existence of a variety of compounds like pyridine, hydroquinone monobenzyl ether, docosane, dotriacontane, (R,Z)-12-hydroxy-9-octadecenoic acid, 2-isopropyl-2,5-dihydrofuran and more [25–31].

Medicinal Uses

Unani Medicine: In his tome titled "Mujarrabat-e-Qadri", Hakeem Abdul Qadir (1931) hath commended the usage of Bisehri-Booti to alleviate renal and vesicular calculi.[5] Certain reputable practitioners of Tibb-e-Unani in Aligarh and Amroha hath employed this plant with efficacious outcomes in treating other maladies, such as albuminuria, haematuria, and prostatitis. The root is purported to possess demulcent diuretic properties and is deemed beneficial in treating strangury according to Ayurveda [7, 32] The entire herb is considered Sitayam and is utilized in Rikta-pita (Haematamasis) and Diabetes [13].

The usage of *A. lanata* is widespread in Sri Lanka to alleviate symptoms of indigestion and coughing [33]. In the state of Bihar, this plant is employed to treat white urine, diarrhoea, cholera, dysentery, and even snake bites [2]. The extract of the plant is believed to have anthelmintic and diuretic properties [3, 34]. Additionally, it is claimed that the plant possesses refrigerant, diuretic, sodiferic, stimulant, and vermifuge properties.[35] The flowers or flowering tops of the plant have been reported to be effective in treating headaches [17, 36]. Furthermore, the juice extracted from the root is applied on the forehead to provide relief from headaches.

Tripathi and colleagues conducted a study to investigate the impact of an alcoholic extract of *A. lanata* on the blood pressure and ECG of anaesthetized rats, as well as on isolated frog heart preparations. They found that at a dose of 10mg/kg, the extract reduced blood pressure without affecting the ECG pattern, whereas higher doses (50mg/kg) produced negative chronotropic effects and extrasystoles. Additionally, at doses of 1-3mg/ml of perfusion fluid, the extract had an inotropic effect on frog heart preparations. Furthermore, the researchers tested various parts of the plant, including the flower, leaf, stem, and root, in raw and dried forms, for their diuretic properties. The study found that fresh plant extracts significantly increased urine output, and the extract obtained from fresh flowers induced the most significant diuresis. Raw flower extract was found to be the most effective in producing diuresis compared to other parts of the raw plant and the dried form. The study suggests that *A. lanata* has a potent diuretic activity, with dried *A. lanata* having a moderate diuretic activity, possibly due to the destruction or partial transformation of the diuretic factor during the drying process. Furthermore, the flowers of the plant contained a higher concentration of the diuretic factor compared to the leaves, roots, and stem, which had a diminishing diuretic effect in descending order [8, 9].

MATERIAL AND METHODS

The test drug namely Bisehri booti (*A. lanata*) was obtained from the herbarium of Department of Ilmul Advia, A.M.U., Aligarh, after proper identification in the light of botanical information. The test drug was used

for experimental study in two forms, i.e. aqueous extract and fresh plant juice.

Extract: The drug was collected in the month of October, dried in air and powdered. The powder then was extracted for 6 hours, in distilled water. The extract was filtered and the solvent was evaporated on water bath. The extract obtained was 1/10th of the air dried plant.

Juice: The Juice was made from fresh plant at the time of experiment; the fresh plants were collected, crushed and squeezed with the help of a special squeezer.

Study for Diuretic Activity

The test for diuretic activity was carried out by the method of Taylor et al. (1962) modified by us [37]. Albino rats of approximately the same weight were divided into 4 groups of 5 animals each. The animals in Group I serving as control fed with 3.0 ml of normal were saline. The animals in Group II serving as the standard were administered with standard drug viz. 0.5mg/100gm of Hydrochlorthiazide, by oral route. The animals in Group III and IV were administered with 20mg/100gm of juice and the aqueous extract of the plant dissolved in distilled water, respectively, by oral route. The animals in Group II, III, and IV were also administered NaCl solution of a strength and in a volume so that they received water and NaCl equal to 3.00 ml of normal saline given to standard and control animals. All the animals were immediately placed, individually, in metabolic cages and the urine passed over 6 hours was collected. The volume of the urine was measured and the concentration of sodium estimated by Flame Photometry. The volume and sodium content of the animals of various groups was the urine statistically compared and analysed by Student's "t" Test.

RESULTS

The mean urine volume measured over 6 hours in the group treated with the Juice of *A. lanata* was 1.675 ml which is 3 times more than in the control group i.e. 0.575 ml and sodium content of this group was 2058.312 ± 95.62 ppm, which is also higher than the urinary sodium of control group i.e. 1816.648 ± 190.63 ppm (p> 0.025). The mean urine volume in group treated with extract of *A. lanata* amounted to 1.4 ml and the sodium content of urine was 1974.98 ± 170.84 ppm which is also higher than the urinary sodium of the control group (p<0.025). The urine volume in the standard group treated with hydrochlorthiazide (0.5 mg / 100 g) was 4.3 ml (p<0.0010) and sodium content of urine was 2291.643 ± 164.638 (p<0.010). The results are presented in table no. 1 & 2 and figure no 1 & 2.

Table No. 1: Effect of bisehri booti (*A. lanata*) on urine output.

Group	Urine passed
Normal Saline	0.575 ± 0.147
Hydrochlorthiazide (0.5mg / 100g)	4.3 ± 0.61**
Extract (20mg /100g)	1.4 ± 0.24*
Juice (20mg /100g)	1.675 ± 0.23*

(mean ± S.E.M.), n=5, *= p<0.025, **= p<0.0005.

Table No. 2: Effect of Bisehri booti (*A. lanata*) on sodium excretion.

Groups	Sodium excreted
Normal Saline	1816.648 ± 190.63
Hydrochlorthiazide (0.5mg/ 100g)	2291.643 ± 164.638**
Extract (20mg /100g)	1974.98 ± 170.84*
Juice (20mg /100g)	2058.312 ± 95.62*

(mean ± S.E.M.), n = 5, *= p<0.025, **= p<0.0005

DISCUSSION

The aqueous extract and the juice of Bisehri Booti (*A. lanata*) were studied, each at the dose 15 mg / 100 g and 20 mg / 100 g, in albino rats. The test drug was studied for diuretic activity by the measurement of urinary volume and sodium in albino rats.

Since the test drug is reported to be effective in renal disorders it was thought that it may possess diuretic activity also. Therefore, it tested for diuretic was activity by the method of Taylor et. al. (1962). Albino rats of either sex was divided into 4 groups of 5 animals each. The animals in Group I were fed with normal saline and the animals in Group II were administered with standard drug viz. 0.5 mg/100 g hydrochlorothiazide by oral route. The animals in group III and IV were administered with 20 mg/100 gm of aqueous extract and juice of the Bisehri booti (*A. lanata*), respectively. The animal was placed in metabolic cages immediately and volume of the urine passed over six hours collected and measured. The sodium concentration was estimated by flame photometry. In the control animals the urine volume and Sodium were found to be 0.575 ± 0.147 ml and 1816.648 ± 190.63 ppm, while in the standard animals treated with hydrochlorothiazide they were significantly increased to 4.3 ± 0.61 ml and 2291.643 ± 164.638 ppm (p<0.0005), respectively. In the animals treated with aqueous extract and the juice, these parameters were found to be significantly increased to 1.4 ± 0.24 ml and 1974.98 ± 170.84 ppm and 1.675 ± 0.23 ml and 2058.312 ± 95.62 pmm (p<0.025), respectively. Therefore, the study shows that Bisehri booti possesses moderate diuretic activity with the

juice being more active than the extract. This finding is at variance with the demonstration of steroidal activity in the test drug in present study. However, it is possible that the test plant possesses two or more active principles having steroidal and diuretic activity, respectively. If this is the case Bisehri Booti will be a better drug for renal ailments as it would exert steroidal activity without the water and sodium retention which is an undesired effect of steroidal drugs. Since steroidal agents have metabolic effects also therefore due to the demonstration of steroidal activity.

CONCLUSION

In conclusion, this study examined the diuretic activity of the aqueous extract and juice of Bisehri Booti (*A. lanata*) in albino rats at doses of 15 mg / 100 g and 20 mg / 100 g. The results showed that both the extract and juice increased urine volume and sodium concentration, indicating moderate diuretic activity. Interestingly, the juice was found to be more effective than the extract. While this finding is inconsistent with the previously demonstrated steroidal activity of the plant, it is possible that Bisehri Booti contains multiple active principles with both steroidal and diuretic effects. If this is the case, Bisehri Booti could be a superior treatment option for renal disorders as it would provide the benefits of steroidal activity without the undesirable effects of water and sodium retention. This study provides further support for the potential medicinal uses of Bisehri Booti in traditional medicine.

CONFLICT OF INTEREST

None declared.

REFERENCES

1. Trimen H: A Hand Book to the Flora of Cylon. Part. III. M / S Bishen Singh Mahendra Pal Singh, New Cannaught Place, Dehli, India, 402-403, 1974.
2. Jain SK, Trafdar CR.: Medicinal Plant - lore of Santals (A review of P.O. Bodding's work). Eco Bot. 1970;24:244.
3. Asolker LV, Kakkar KK, Chakre J: Second Supplement to Glossary of Indian Medicinal Plants with Active Principles . Part-1. Publication & Information Directorate (C.S.I.R.), New Delhi, India p.27, 1992.
4. Nadkarni KM: Indian Mataria Medica. Popular Book Depot, Bombay, India, p.49, 1976.
5. Qadir MA: Mujarrabat-E-Qadri, Mohan Printing Press, Aligarh, India, p. 207, 1930.
6. Afaq SH, Tajuddin, Afridi RM: Bisehri Booti (*A. lanata*): Some lesser known uses and pharmaconosy. Ethnobotany. 1991;3:91-94.
7. Kirtikar KR, Basu BD: Indian Medicinal Plant Vol. IIIrd. International Book Distributors, Rajpur, Dehra Dun, India, p. 206, 1987.
8. Tripathi HC, Chandra S, Lal J. Cardiovascular Effect of Aerva lanata. Indian J Pharm. 1985;17: 42.
9. Udupihille M, Jiffry M: Diuretic Effect of Aerva lanata with Water, Normal Saline and Corander as Control, Indian J Physiol Pharmacol. 1986; 30: 91-97.
10. Dhawan BN, Duley MP, Mehrotra BN, Rastogi RP, Tandon JS: Screening of Indian Plants for Biological Activity. Part IX. Indian J Exp Biol. 1980;18: 594.
11. https://plants.usda.gov/home/classification/55659 [Accessed on Mar 2023].
12. Collett H: Flora Simlensis, A Hand Book of the Flowering Plants of Simla and the Neighbourhood. Calcutta; Simla. Thacker, Spink; Co. India, p.414, 1921.
13. Karnick CR: Some Aspects of Crude Indian Drug Plants in Ayurvedic System of Medicine for Madhumya (Diatbetes) Actaphytotherapeutics. 1972;8:141-147.
14. Kapoor SL, Kapoor LD: on the Botany and Distribution of "Pashanbhed" Sachitra Ayurveda. 1976; 769-791.
15. Duthie JF : Flora of Upper Gangotic Plain and of the Adjacent Siwalik and Sub Himalyan Tract (1960) Vol.1 , Part 1. Bishen Singh Mahendra Pal Singh. Delhi, India.
16. Mary TN, Prabha SA: Geology of *A. lanata* Juss. Geobios. 1980;7(6):285-86.
17. Patnaik H: Some Medicinal Plants Around Cuttak. J Bomb Nat Hist Soc. 1956;54(1)140-152.
18. Thiselton-Dyre; WT: Flora of Tropical Africa Vol.VI. Published Under the Authority of the State for the Colonies. L. Reeve & Co. Ltd. The Oast House, Brook Ashfort, Ken, England, 1913:39-40.
19. Afridi RM: Pharmacognostical Studies of certain Unani Medicinal Plants. M.D. Thesis. 1992. Dept. of Ilmul Advia, AMU, Aligarh, India.
20. Bamber CJ: Plants of Punjab, A Descriptive Key to the Flora of the Punjab, North-west, Frontier

Province and Kashmir. M / S Periodical Experts. Dehli, India, p. 315, 1976.

21. Aiyer VN, Narayan V, Sheshadri TR, Vaidyasaran: Chemical Components of Some Indian Medicinal Plants. Indian J Chem. 1973; 11:89-90.
22. Sastry CSP, Siraj PG: Analytical Studies Leading to Standardisation of *Aerva lanata* Juss (Ayurvedic Medicine) Indian J Pharmacy. 1977; 6:174.
23. Yognarasimhan SN, Nair KV, Murthy KRK. Medico-Botany of Karnataka, Utilisation of Floristic of Kankapur Wealth for the Economic Development Taluk, Bangalore District. J Econ Texo Bot. 1985;6(1):97-107.
24. Gertruda Z, Vladimir K, Victor O, Anatoly M: Canthin - 6 - one and Beta corboline Alkaloids from *Aerva lanata*. Planta Medica. 1991;58(2):192-196.
25. Yamunadevi M, Wesely EG, Johnson MA. FTIR spectroscopic studies on *Aerva lanata* (L.) Juss. Ex Schult. Asian J Pharm Clin Res. 2012;5:82-86.
26. Omoyeni OA, Adeyeye EI. Chemical composition, calcium, zinc and phytate interrelationships in *Aerva lanata* (Linn) Juss. ex Schult leaves. Orient J Chem. 2009; 25:485-488.
27. Ragavendran P, Arul Raj C, Sophia D, Starlin T, Gopalakrishnan VK. Elemental analysis of *Aerva lanata* (L.) by EDX method. Int Res J Pharm. 2012;3:218-220.
28. Vijayalakshmi R, Ravindhran R. HPTLC method for quantitative determination of gallic acid in ethanolic root extract of Diospyrus ferrea (Willd.) Bakh and *Aerva lanata* (L.) Juss. Ex Schultes-A potent Indian medicinal plants. Asian J Pharm Clin Res. 2012;5:82-86.
29. Vijayalakshmi R, Ravindhran R. Preliminary comparative phytochemical screening of root extracts of *Diospyrus ferrea* (Willd.) Bakh and Aerva lanata (L.) Juss. Ex Schultes. Asian J Plant Sci Res. 2012; 2:581-587.
30. Kumar G, Karthik L, Bhaskara Rao KV. Phytochemical composition and in vitro antioxidant activity of aqueous extract of *Aerva lanata* (L.) Juss. ex Schult. Stem (Amaranthaceae). Asian Pac J Trop Med. 2013; 6:180-187.
31. Mariswamy Y, Gnanaraj WE, Antonisamy JN, Adaikalam AA, Jamesraj V. GC-MS studies on methanolic extracts of Aerva lanata L. Indo American J Pharmaceut Res. 2013; 3:2687-2717.
32. Bedi SJ: Ethnobotany of Ratan Mahal Hills, Gujarat, India. Eco Bot. 1978;32 (3):278-84.
33. Trimen H: A Hand Book to the Flora of Ceylon. Part. III. M/s Bishen Singh Mahendra Pal Singh, New Cannaught Place, Dehli, India, 402-403, 1974.
34. Srivastava JG: "Pashanbhed" Quart. J. Crud. Drug Res. 1971;11(1):1683-1669.
35. Chandra S, Sastry MS: Chemical Constituents of Aerva lanata . Fitotropia. 1990;61(1):188.
36. Maheshwari JK: The Flora of Delhi. Publication & Information Directorate (C.S.I.R.), New Delhi, pp. 294, 1963.
37. Taylor RM, Topliss JG: Structure Activity Relationship of 3-Substituted Dihydrobenzothiazine Diuretics. J Med Pharma Chem. 1962;4:312.