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# *Cardosoa*, a new genus of the subtribe Anisopappinae (Athroismeae, Asteraceae)

by

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## Abstract

Ortiz, S. 2010. *Cardosoa*, a new genus of the subtribe Anisopappinae (Athroismeae, Asteraceae). *Anales Jard. Bot. Madrid*. 67(1): 7-11.

The new genus *Cardosoa* of the subtribe Anisopappinae (Athroismeae, Asteraceae) is described for the species *Anisopappus athansioides* from the Angola Plateau. The diagnostic morphological characteristics of the new genus are discussed, and contrasted to those in *Anisopappus* its putative sister genus. The main distinguishing features of *Cardosoa* in Athroismeae are its inflorescence morphology, the bilabiate marginal florets, and shallowly zygomorphic disc florets.

**Keywords:** Asteridae, Compositae, Tropical Africa, Angola, Huambo, systematics, taxonomy, morphology.

## Resumen

Ortiz, S. 2010. *Cardosoa*, un nuevo género de la subtribu Anisopappinae (Athroismeae, Asteraceae). *Anales Jard. Bot. Madrid*. 67(1): 7-11 (en inglés).

Se describe el nuevo género *Cardosoa* de la subtribu Anisopappinae (Athroismeae, Asteraceae) para la especie *Anisopappus athansioides* del planalto de Angola. Se discuten los caracteres morfológicos más distintivos del nuevo género, especialmente frente a *Anisopappus*. Los caracteres morfológicos de mayor valor diagnóstico son el tipo de inflorescencia y la presencia en *Cardosoa* de flores marginales bilabiadas y flores del disco zigomorfas en mayor o menor medida.

**Palabras clave:** Asteridae, Compositae, África tropical, Angola, Huambo, sistemática, taxonomía, morfología.

## Introduction

In 1995 Ortiz & Paiva described the species *Anisopappus athansioides* (Asteraceae) from somewhat immature material collected by H. Cardoso in Chianga (Huambo), on the Angola Plateau. Eldenäs & Anderberg (1996: 174) considered the specimen from which it was described to be “significantly different from all other species of *Anisopappus*”. We subsequently found more complete material of this taxon and discovered that, besides its distinct capitula and inflorescence, it has bilabiate (i.e. with one adaxial and three abaxial lobes) marginal florets when mature, very different to those of *Anisopappus* Hook & Arn., which always are true ray florets. In view of these and other very marked morphological differences with respect to *Anisopappus* and other related members of the Asteraceae, we describe a new genus for this species.

## Material and methods

Morphological characters were studied in herbarium specimens of the 18 species of *Anisopappus* (including *A. athansioides*) from BM, COI, K, LISC, LISE, LISU, LUA, LUAI, P and PRE.

Macromorphological characters were studied with the aid of a light microscope. For microscopic examination of floral parts, these were first boiled in water with a surfactant, and subsequently mounted in Hoyer's solution (Anderson, 1954). Cypsela sections were cut by hand with razor blades. Micromorphological and anatomical characters were studied with a compound light microscope.

For examination of corolla and cypsela features, florets were mounted on aluminium stubs and coated with a c. 30-nm gold layer for study with a LEO 435VP scanning electron microscope (SEM) operating at 15 kV.



## Description

### *Cardosoa* S. Ortiz & Paiva, **gen. nov.**

Type species: *Cardosoa atbanasioides* (Paiva & S. Ortiz) S. Ortiz & Paiva, *comb. nov.* – *Anisopappus atbanasioides* Paiva & S. Ortiz in Bot. J. Linn. Soc. 117: 40 (1995) (Basion.). TYPE: Angola, Huambo district, Huambo, Chianga, 1700 m, 10 May 1965, wasteland and grassy areas, *Helder Cardoso s.n.* (COI, holotypus).

*A genere Anisopappus differt capitulis racemosis, floribus marginalibus capituli uniuscuisque bilabiatis - limbo quidem abaxiali 1.5-2 mm longo nervisque lobulorum usque ad basin divis - floribusque centralibus plus minusve zygomorphis ob lobulorum corollinarum inaequalem satis incisionem.*

Subshrubs. Stems terete, without resin canals, herbaceous parts with multiseptate hairs. Leaves alternate, simple, entire, linear, with revolute margins, with short petioles or petioles wanting. Capitula cyathiform, arranged in racemiform cymes (Fig. 1a); phyllaries in 3-4 rows, acute, with non-scarious margins. Receptacles flat, paleate; paleae folded, acute, with glandulose apices. Marginal florets female, sometimes with staminodes, in one row. Corolla bilabiate (Fig. 1b), with one adaxial and three abaxial lobes (very rarely pseudobilabiate, with one adaxial and four abaxial lobes), yellow. Disc florets perfect. Corolla tubular, slightly zygomorphic, with straight epidermal-cell walls, without crystals, yellow; corolla lobes 5, short, with the depth of the sinuses varying among them (Figs. 1c, 2c), without sclerenchymatous cells accompanying the submarginal narrow vascular strands. Stamen filaments without oxalate crystals; anthers shortly calcarate, with short, unbranched tails; endothelial tissue polarized; cells of filament collar wider than long. Style without star-shaped oxalate crystals, with obtuse sweeping-hairs not reaching the style branch bifurcation; style branches with obtuse, rounded apices, stigmatic areas in two apically confluent lines, style branch veins narrow. Cypselae (immature) cylindrical to slightly obconic (Figs. 1b, 1c), ribbed, hairy, without conspicuous sclerenchymatic tissue, with small oxalate crystals of diverse shape (as “crystal sand”) in the epidermis, without secretory ducts; carpodium absent. Pappus of inconspicuous short scales (Fig. 1b, c; line drawing in Ortiz & Paiva, 1995; Fig. 1).

### *Other representative specimen examined*

ANGOLA. **Huambo:** Chianga, ca. 1700 m, 7-V-1967, *M. Silva* 2070 (LISC); 10 km from Cachiungo on the right side of the road Cachiungo-Bailundo, 1.5 km from the river Ko, ca. 1700 m, 23-VI-2007, *S. Ortiz* 847, *J.A.R. Paiva*, *J. Rodríguez-Oubiña*, *R. Carballal*, *M. Serrano* & *M. Soares* (SANT)

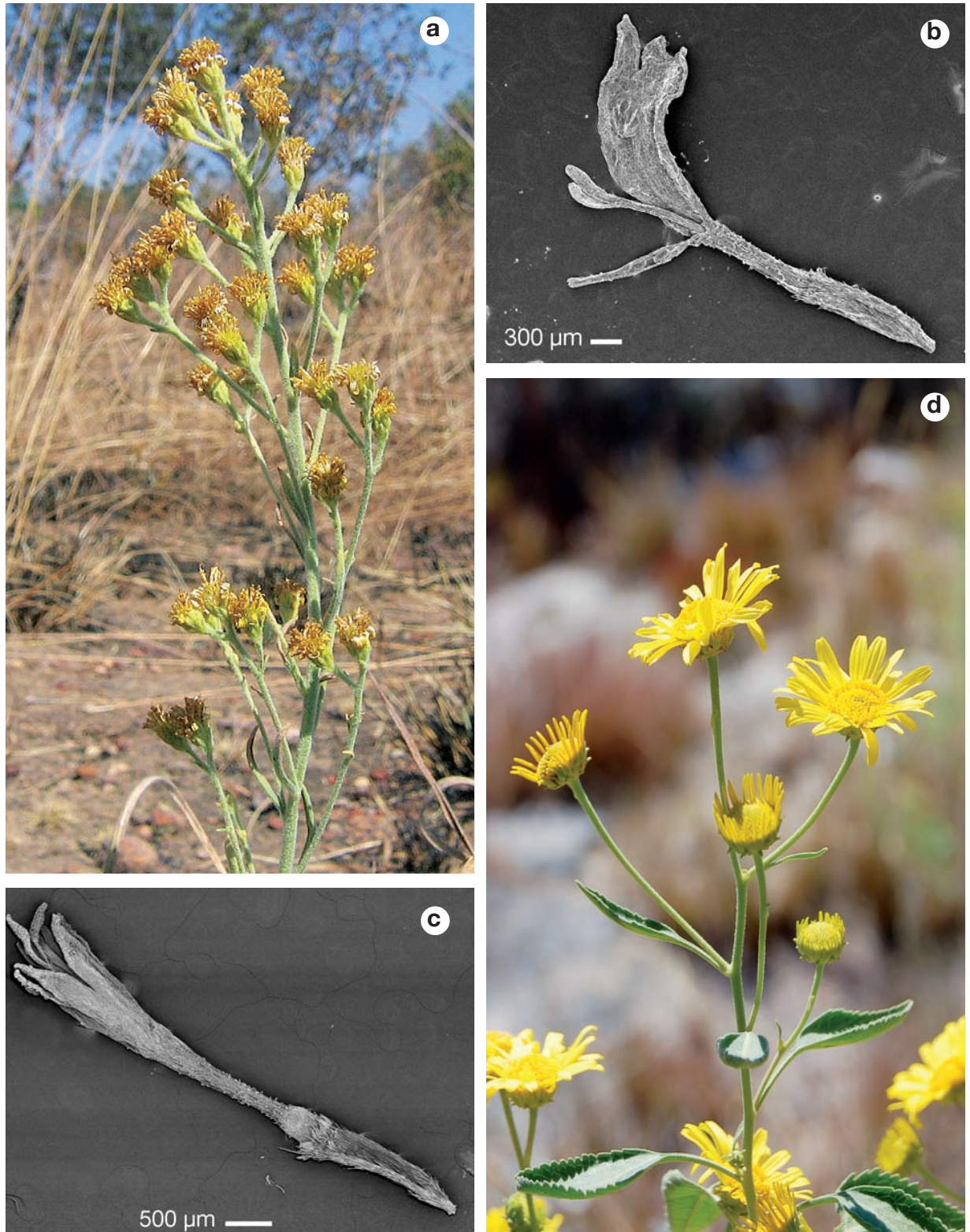
The generic name honors Helder Cardoso, the first collector of this plant, and João Cardoso, who has accompanied us and provided invaluable help during our collecting trips in Angola.

## Discussion

As a result of a molecular phylogenetic analysis using the cpDNA marker *ndhF*, Eldenäs & al. (1999) suggested that *Anisopappus* should be assigned to Heliantheae s.l. instead of Inuleae as proposed by several authors in the last decade (Anderberg, 1991; Anderberg, 1994; Eldenäs & Anderberg, 1996; Ortiz & al., 1996; Eldenäs & al., 1998). In that analysis *Anisopappus* forms a trichotomy with the *Athroisma*-*Blepharispermum* group and with the remaining genera of Heliantheae s.l. Panero & Funk (2002), on the basis of a phylogenetic analysis of the entire Asteraceae family using a large number of chloroplast DNA markers, suggested that the group *Athroisma*-*Blepharispermum*, already found by Kim & Jansen (1995) in their analysis of the Asteraceae using the marker *ndhF*, should be considered a tribe, which they denominate Athroismeae (including the genera *Athroisma* DC., *Blepharispermum* Wight ex DC., and *Leucoblepharis* Arn.), phylogenetically situated between a) a clade including the tribes Inuleae and Plucheeae - the latter currently included in Inuleae by its author (Anderberg & Eldenäs, 2007; Anderberg, 2009) - and b) a large monophyletic group including the rest of subfamily Asteroideae (Heliantheae s.l.). A similar position for this tribe is also supported by the phylogenetic analyses of Panero & Funk (2008). These authors had already noted the possibility of including *Anisopappus* in this tribe. Also recently Panero (2005) described the new subtribe Anisopappinae, with the sole genus *Anisopappus*, within the tribe Athroismeae. In 2007 Panero also included in Anisopappinae the genus *Wehwitschiella* O. Hoffm. although more recently Anderberg (2009) removed this genus from the Athroismeae based on his preliminary molecular phylogenetic analyses which nested it within the tribe Astereae as was confirmed by Brouillet & al. (2009). *Cardosoa* is very probably a member of that subtribe taking into account its morphological affinities to *Anisopappus* and we are currently carrying out a molecular phylogenetic analyses using the markers ITS and *ndhF* to check the relationships of *Cardosoa*.

Differences in inflorescence morphology can be readily used to separate *Cardosoa* from its putative sister taxon *Anisopappus*. *Cardosoa* has racemiform cymes (Fig. 1a) whereas the genus *Anisopappus*, has corymbose or subcorymbose cymes (Fig. 1d), sometimes with capitula on long peduncles that appear





**Fig. 1.** Inflorescence (*S. Ortiz 847, J.A.R. Paiva, J. Rodríguez-Oubiña, R. Carballal, M. Serrano & M. Soares, SANT*) and SEM micrographs of florets (*M. Silva 2070, LISC*) of *Cardosoa athanasioides* and inflorescence of *Anisopappus fruticosus* *S. Ortiz & Paiva (S. Ortiz 885, J.A.R. Paiva, J. Rodríguez-Oubiña, R. Carballal, M. Serrano & M. Soares, SANT)*: **a**, inflorescence of *C. athanasioides*; **b**, marginal bilabiate floret of *C. athanasioides*; **c**, disc floret of *C. athanasioides*, note the different depths of the lobe sinuses; **d**, inflorescence of *A. fruticosus*.



**Fig. 2.** Light microscopy photographs of florets of *Cardosoa athanasioides* (M. Silva 2070, LISC) and *Anisopappus chinensis* subsp. *chinensis* (B. Teixeira & Andrade 8233, COL); **a**, lower lip of a ray floret of *C. athanasioides* showing the nerves of the apical lobes which remain separate to the base of the limb; **b**, apex of a ray floret in *A. chinensis* where the nerves of the apical lobes join close to the sinuses; **c**, corolla of a disc floret of *C. athanasioides* showing variation in the depth of the sinuses. Scale = 0.1 mm.

solitary [*A. chinensis* Hook. & Arn., *A. grangeoides* (Vatke & Höpfner ex Klatt) Merxm., *A. marianus* Lawalrée, etc.].

The involucre of *Cardosoa* is cyathiform (Fig. 1a), whereas in *Anisopappus* it is campanulate to hemispheric (Fig. 1d). Only *A. smutsii* Hutch. and *A. pseudopinnatifidus* S. Ortiz & Paiva have an involucre similar to that of *Cardosoa*.

The marginal florets of *Cardosoa* are bilabiate (one adaxial and three abaxial lobes) (Fig. 1b) or very rarely pseudobilabiate (one adaxial and four abaxial lobes), whereas the marginal florets of *Anisopappus* are always true ray florets (Fig. 1d). In addition, the marginal florets of *Anisopappus* are much larger than those of *Cardosoa* (abaxial limb 4-13 mm long in *Anisopappus* versus 1.5-2 mm long in *Cardosoa*), though in some species (such as *A. pinnatifidus* (Klatt) O. Hoffm., *A. pseudopinnatifidus* and *A. chinensis* subsp. *scrophulariifolius* (Baker) S. Ortiz, Paiva & Rodr. Oubiña) the ray florets may be absent. *Cardosoa* also differs from *Anisopappus* in the nerves of the apical lobes of the abaxial limb, which remain sepa-

rate to the base of the limb (Fig. 2a), whereas in *Anisopappus* these nerves normally join close to the sinuses (Fig. 2b).

The disc florets of *Cardosoa* are zygomorphic, with the depth of the sinuses varying among lobes (Figs. 1c, 2c); in *Anisopappus*, by contrast, the disc florets are actinomorphic. In *Cardosoa*, the lobes are conspicuously more acuminate, with the nerve clearly extending to the apices (Fig. 2a); we have not observed this character in any of the species of *Anisopappus*.

The anthers of *Cardosoa* have a conspicuously apiculate apical appendage whereas in *Anisopappus* the apical appendage is acute, not apiculate.

The cypselae are not fully mature in the *Cardosoa* material available, but appear to differ markedly from those of *Anisopappus*, to judge from the number of nerves and incipient ribs: in *Cardosoa* the number of nerves per cypselae seems always to be less than or equal to 5, and the number of ribs less than 10, whereas in *Anisopappus* the number of nerves is characteristically 5-10(20?), and the number of ribs 10-20. The single exception to this is *A. latifolius* (S. Moore) B.L. Burt, a distinctive species found to be sister to the other species of *Anisopappus* in the morphological cladistic analyses of Eldenäs & Anderberg (1996).

#### KEY TO THE GENERA OF ANISOPAPPINAE (SENSU PANERO, 2007)

1. Capitula disciform; receptacle epaleate; marginal florets generally tetramerous; pappus a crown of scales fused at the base ..... **Welwitschiella**.
1. Capitula radiate or rarely discoid; receptacle paleate, rarely epaleate; marginal florets generally pentamerous; pappus of small  $\pm$  free scales or absent .... 2
2. Capitula arranged in racemiform cymes; marginal florets bilabiate (rarely pseudobilabiate), with an abaxial limb 1.5-2 mm long and the nerves of the apical lobes separated to the base of the limb; disc florets more or less zygomorphic, sinuses depth varying among the lobes; apical appendage of the anther conspicuously apiculate; cypselae with up to 5 nerves and 10 ribs ..... **Cardosoa**
2. Capitula arranged on more or less lax corymbs; marginal florets true ray florets (rarely absent), with abaxial limb 4-12 mm long and nerves of the apical lobes joining close to the sinuses; disc florets totally actinomorphic; apical appendage of the anther not apiculate; cypselae with 5-10(20?) nerves and 10-20 ribs ..... **Anisopappus**

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