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Authors: Lack, H. Walter, and Fuentes, Susy

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H. WALTER LACK^{1*} & SUSY FUENTES^{1, 2}

The discovery, naming and typification of *Chenopodium quinoa* (*Chenopodiaceae*)

Abstract

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Willdenow published the name *Chenopodium quinoa* basing it on a living specimen cultivated in Berlin. Herbarium specimens collected by Humboldt and Bonpland in South America were acquired by Willdenow only later. The discovery of this species by Europeans, its first naming by Feuillée, and the early collections brought back by the expedition lead by Ruiz are discussed. In addition a lectotype is chosen for *C. quinoa*.

Additional key words: pre-Columbian records, early botanical exploration of South America, Ruiz, Willdenow, Humboldt

1. Introduction

Following a proposal from the Food and Agriculture Organization (FAO), the General Assembly of the United Nations has declared 2013 the International Year of Quinoa (IYQ) “recognizing the Andean indigenous peoples, who have maintained, controlled, protected and preserved quinoa as food for present and future generations thanks to their traditional knowledge and practices” (Anon. 2012). It is notable that the original proposal to FAO came from Bolivia.

Because of its cold- and drought-tolerance quinoa is of outstanding importance in altiplano agriculture in South America as practised from Southern Columbia to northern Chile and western Argentina. In Quechua it is called “chisiya mama” [mother grain] and was regarded as a sacred plant by the Incas, who called it the golden seed and offered it to their gods (Anon 1989). Today for millions quinoa continues to be a major source of high quality protein with an excellent amino acid balance and

is cultivated now also outside America (Anon. 2011). Traditionally the achenes are prepared like rice or used to thicken soups, but some varieties are also popped like popcorn (Anon. 1989). It seems appropriate on the occasion of the IYQ to devote a paper to the discovery and naming of quinoa by Europeans and to include a note on its typification.

Unless otherwise indicated, biographical information is taken from reference works, notably Stafleu & Cowan (1976, 1979, 1981, 1983, 1986, 1988), Stafleu & Mennega (1992–93, 1995, 1997–98, 2000) and Dorr & Nicolson (2008–09).

2. Feuillée O. M.

Quinoa (*Chenopodium quinoa* Willd.) is an ancient crop: macrobotanical remains of a quinoa-like chenopod from sealed house floors and hearths found on the lower western slopes of the Andes in northern Peru have been dated

1 Botanischer Garten und Botanisches Museum Berlin-Dahlem, Freie Universität Berlin, Königin-Luise-Str. 6–8, 14195 Berlin, Germany; *e-mail: h.w.lack@bgbm.org (author for correspondence), s.fuentes@bgbm.org

2 Herbario Nacional de Bolivia, c/ Nro. 27 Cota Cota, Campus Universitario UMSA, La Paz, Bolivia.

as early as the Las Pircas period (9800–7800 years B.P.; Dillehay & al. 2007; Dillehay 2011). This material has recently been interpreted as perhaps indicative of the pre-domestication cultivation phase of use (Dillehay 2011). Later findings have been associated with the Thiahunaco culture distributed from Southern Peru through Bolivia to Northern Chile (Bruno & Whirehead 2003).

The term “quinua” seems to have first appeared in a report sent in 1551 by Pedro Valdivia to Carlos I, King of Spain (as Charles V Emperor of the Holy Roman Empire), which was published only three centuries later (fide Hunziker 1952). It referred to economic plants found in the surroundings of Concepción in present-day Chile; however, no further information on the plant or its use is given. In print the term “quinoa” appeared for the first time in 1553 in an exceedingly rare report by one of the Spanish invaders, the “Parte primera de la chronica del Peru” (Cieza de León 1553; cf. Bray 2003) and referred to the inhabitants of Quito in modern Ecuador. Cieza de León stressed the tiny fruits of the plant and mentions that they are eaten boiled like rice and used for preparing drinks; however, no locality is given to which this observation refers.

The first proper description of *Chenopodium quinoa* seems to be that given by Father Louis Éconches Feuillée, a member of the mendicant order of the Minims, mathematician and botanist to Louis XIV, King of France. In 1709–1711 he had visited the Spanish colonies in South America, staying in what are now Argentina, Chile, and Peru. Back in France, Feuillée published a detailed travel account dedicated to the monarch and named “Journal des observations physiques, mathématiques et botaniques” (Feuillée 1714, 1725). Its third volume appeared in 1725 and contains the second part of an account referring to medicinal plants entitled “Histoire des plantes medicinales qui sont le plus en usage aux Royaumes du Perou & du Chily dans l’Amerique Meridionale”. Here we find a brief description of *C. quinoa*, named “Chenopodium, folio sinuato saturè virente, vulgò Quinoa”, with the explicit note that the plant is cultivated in gardens (Feuillée 1725: 15). The fruit – “une petite graine blanche, plate, ronde, d’une ligne de diameter” – evidently attracted Feuillée’s special attention. No precise locality is indicated, since the author mentions only that the fruits were used in Peru and in all other parts of America like rice in Europe. In addition, Feuillée arranged for the inclusion of a copper engraving possibly based on his own drawing showing on the left the new plant, albeit a juvenile specimen (Fig. 1); however, at least enlarged presentations of a flower and a fruit were included and consequently there seems to have been never any doubt about its identity (e.g. Philippi 1867). No specimens collected by Feuillée are known to exist (Stafleu & Cowan 1976), though the possibility cannot be excluded that a specimen of *C. quinoa* in the Lamarck-Herbarium (P 00381089) labeled “Chenopodium sineuse” in Lamarck’s hand might be connected with the intrepid Minim brother; after all

the very term *sineuse*, possibly an orthographic error for *sinueuse*, had been used by Feuillée when describing the leaf margin of his plant (see above). For several decades Feuillée’s text and illustration seem to have been the only record of *C. quinoa* in Europe, since the Spanish authorities restricted access to their colonial empire to citizens of the home country and only rarely permitted exceptions; in addition, at that time interest in plant life was rather limited.

Although Linnaeus based several names exclusively on illustrations published in Feuillée’s Journal, e.g. *Solanum montanum* L. (Knapp & Jarvis 1990), for reasons unknown he disregarded the engraving showing *Chenopodium quinoa*. In a sense this is surprising, since Feuillée’s descriptions and engravings were among the very few sources on the flora of South America available to him. In addition, the “Histoire des plantes medicinales” had been translated during Linnaeus’s lifetime into German, published first in Nürnberg (Feuillée 1756–58; translation attributed to G. L. Huth), and later as a reissue without the plates, again in Nürnberg (Feuillée 1766; no translator indicated).

Both German versions did not use binomial nomenclature, giving *Chenopodium quinoa* as “Der Gänsefuß mit dem ausgeschweiften dunkelgrünen Blatt, in gemein quinoa. Chenopodium, folio sinuato saturè virente, vulgò quinoa”, and therefore they are not relevant for the ICN (Melbourne Code; McNeill & al. 2012). Even before this Code, the generic names published in the German translation of Feuillée’s Journal and its reissue had been listed as *Opera utique oppressa* in the ICBN (Vienna Code; McNeill & al. 2006).

3. Ruiz, Pavón & Dombey

A vast amount of information is available on the famous “Real Expedición Botánica al virreinato del Perú”, which significantly augmented our knowledge of plant life in what is now Chile and Peru, resulted in extensive collections and became the subject of several in-depth studies (e.g. Steele 1964). However, the publication of the expedition’s results was delayed and in the end totally given up, with only a torso of the “Flora peruviana et chilensis” appearing in print. The complexities of the expedition have recently been analyzed again, though with different foci – with an emphasis on sources kept in Spain (Bueno & Nozal 2003; Nozal 2003; Guillén & Paz 2003), and in France (Lang 1988). The whole project was commissioned by Carlos III, King of Spain, led by Hipólito Ruiz López, first botanist and head of the expedition, and included among its participants José Pavón, second botanist, and Joseph Dombey, “medico naturalista y botánico frances en calidad de acompañado de los Españoles de la misma profesión” (Lang 1988). In addition, several botanical artists took part in the expedition (listed in Guillén & Paz 2003). Right from the beginning it had been



Fig. 1. *Chenopodium quinoa*, anonymous engraving. – Feuillée, Journal des observations physiques, mathématiques et botaniques 3: t. 10. 1725, Paris. – Berlin, Freie Universität, Universitätsbibliothek.

laid down in the instructions that Dombey's collections were to be divided: one part was to belong to the King of Spain, the other to the King of France, the latter portion destined for the Cabinet du Roy in Paris.

Several specimens of *Chenopodium quinoa* collected during the course of this expedition have survived in European herbaria. Four specimens collected by Dombey are kept in P, with locality information given as "Concepcion del chili" (P 05007641), "Chili" (P 05007634, P 05007636) and the enigmatic note "H Cr" (P 05007632), but dates are missing. Two further specimens with labels in Dombey's hand are preserved in MA, with collection data given as "in Cultis. 1782. Chili" (MA 811392) and "1782. Concepcion de Chile. Marte" (MA 811393), with the latter bearing a note "posea as mismas propriades al arroz" [having the same qualities as rice] in an unknown hand. Because material of the Expedición Botánico al virreinato del Perú was widely distributed, it is likely that further duplicates will be located in other collections. By contrast, no drawing of *C. quinoa* prepared by a botanical illustrator accompanying the expedition has been found in the archives of the Real Jardín Botánico in Madrid (E. García Guillén pers. comm. 2013).

Upon his return to Cadiz, Dombey was obliged by the Spanish authorities to divide his material (Hamy 1905; Steele 1964). As a consequence a manuscript description referring to *Chenopodium quinoa* ended up in Madrid, where it is kept in the herbarium as MA 811392; it is published for the first time in the annex. This is not a unique situation: a similar case referring to a manuscript description of the genus *Krameria* in Dombey's hand kept in the herbarium at MA, albeit subsequently published, has also come to light (Burdet & Simpson 1983).

Whereas Ruiz mentioned in his travel account (1931; English translations 1940, 1998) several *Chenopodium* species, though not explicitly *C. quinoa*, Dombey refers to this very species in two of his letters sent to correspondents in Paris in 1778 and 1779, respectively, mentioning in both that he had included seed material (Hamy 1905). This is corroborated by a slightly later account (Le Blond 1786), where we find a note that Dombey brought additional seed material on his return to the French capital in 1785; however, in all cases germination failed (Le Blond 1786), a fact later confirmed in one of Dombey's obituaries (Deleuze 1804).

4. Willdenow

Carl Ludwig Willdenow, professor at the Collegium medico-chirurgicum in Berlin and in later years director of the Royal Botanic Garden in Schöneberg near Berlin, seems to have been the first to successfully raise a specimen of *Chenopodium quinoa* in Europe. In the fourth edition of Linnaeus's *Species Plantarum* Willdenow (1798) describes this plant noting "v.v." [vidi vivam], i.e. I saw it as a living plant.

A cultivated juvenile specimen is kept in the Willdenow Herbarium (B-Willd. 5340/1; Fig. 2). The sheet is annotated in the lower right-hand corner "Bouché", which indicates that the material had been cultivated in one of the properties of the Bouché family in Berlin, more specifically a garden belonging to Jean David Bouché. Willdenow's source for this material remains unknown; the Real Jardín Botánico in Madrid would be a reasonable guess, since Willdenow is known to have exchanged letters with Antonio José Cavanilles and his herbarium contains specimens collected by Ruiz and Pavón (Lack 1979), though it is unclear when this material was received. However, it should be noted that the herbarium at MA does not include a single cultivated specimen of *Chenopodium quinoa* collected prior to 1800 (P. Blanco pers. comm. 2012).

Willdenow published the description of his cultivated specimen and validated the name *Chenopodium quinoa* (Willdenow 1798); he added a reference to the German edition of Feuillée's *Journal* (Feuillée 1758), citing the page and illustration. Since Willdenow's protologue is clearly based on two original elements – a specimen and an illustration – a lectotype has to be chosen, and preference is given to the specimen B-Willd. 5340/1.

5. Humboldt & Bonpland

The Willdenow Herbarium contains two more specimens of *Chenopodium quinoa* (B-Willd. 5340/2, 5340/3), both attributed by Diederich Friedrich Carl von Schlechtendahl to Alexander von Humboldt, though judging from the handwriting these sheets were annotated by his travel companion Aimé Bonpland. The first bears the latter's note "var caule contanto rubro", the second "*C. quinoa*"; as is so often the case, a date and information on the collection site are missing, though it is evident that the material must have been gathered by Humboldt and Bonpland in South America. Since they arrived on 7 July 1799 in Cumana in present day Venezuela and reached regions of altiplano agriculture only several months later, it is clear that B-Willd. 5340/2 and 5340/3 are not eligible as type specimens for *C. quinoa*.

Neither the general herbarium at B nor the Herbarium Bonpland, a historical herbarium kept at P, include specimens of this species collected by Humboldt and Bonpland. However, two specimens could be traced in the general herbarium at P referring to the material in the Willdenow Herbarium – one bearing the collection number 1472 in Bonpland's hand (P 05007628), the second bearing the annotation "var. caule rubro" (P 05007633). It seems plausible to assume that B-Willd. 5340/3 and P 05007633 are duplicate specimens, and the same cannot be excluded for B-Willd. 5340/2 and P 05007628, though the collection number of the latter remains enigmatic, being associated with the description of a totally different species in the *Journal Botanique* (Lack 2004).



Fig. 2. Lectotype of *Chenopodium quinoa* – Berlin, Botanischer Garten und Botanisches Museum Berlin-Dahlem, Herbar Willdenow (B-W 05340-01 0 [= B-Wildd. 5340/1] <http://data.bgbm.org/herbarium/BW05340010>).

When Carl Sigismund Kunth published the account of *Chenopodium* in his “Nova Genera et Species Plantarum” (Kunth 1817) he correctly applied Willdenow’s name *C. quinoa* and informally distinguished two infraspecific forms, though he refrained from naming them. The variant “caule rubro” [with a red stem] is given for the locality Riobamba near Quito, the variant “caule viridi” [with a green stem] for the viceroyalty of New Granada (Kunth 1817), an area comprising the present-day states of Colombia, Ecuador, Panama, and Venezuela. In both cases quinoa is indicated as a cultivated plant (Kunth 1817).

Even before the publication of the iconic “Nova genera et species plantarum” Humboldt had mentioned quinoa in his publications, e.g. his “Versuch über den politischen Zustand des Königreichs Neu-Spanien” (Humboldt 1809, 1812), stressing its role in altiplano agriculture in South America and Mexico and pointing out the fact that the term “arroz pequeño” used by early Spanish chroniclers should be interpreted as *Chenopodium quinoa*. However, this is at best doubtful and *C. berlandieri* s.l. is the more plausible determination (Wilson 1990).

Thus the situation can be summarized as:

Chenopodium quinoa Willd., Sp. Pl. 1: 1301. 1798. – **Lectotype (designated here):** [Specimen of unknown origin cultivated by a member of the Bouché family in Berlin, not later than 1798] (B-W 05340-01 0 [= B-Willd. 5340/1] <http://data.bgbm.org/herbarium/BW05340010>) – Fig. 2.

6. Epilogue

No attempt is made here to trace the introduction of quinoa into gardens in Europe. Clearly it started relatively late: Willdenow seems to have been the first to have the plant in cultivation, though he noted that the fruits did not always mature (Willdenow 1798). Further research is necessary to elucidate the precise sequence of events leading to subsequent distribution in European gardens. The belated start of quinoa cultivation in Europe corresponds in a sense to the extremely late publication of the first illustration of a specimen of *Chenopodium quinoa* after Feuillée – appearing as t. 3641 of Curtis’s Botanical Magazine (Hooker 1838). Generally speaking, success of quinoa outside South America was slow in coming, but in the twenty-first century it is now being cultivated as a cash crop on all five continents.

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Appendix

Joseph Dombey’s manuscript description of *Chenopodium quinoa* (MA 811392):

“quinoa *Chenopodium* foliis lanceolato – tricuspidatis, dentatis, acutis, Compositis planta herbacea, annua, 1 – 2–3 – pedalis, erecta, tota glabra. caulis angulatus, simpliciter ramosus, folia oblonga petiolata. pedunculi axillares, racemosi. racemus compositus, ovatus. flores virides, lutei, purpureive. Habitat chili in Cultis. Floret mense february et martio.

Cette plante connue au perou et au chili sous le nom de quinoa donne mil grains au moins pour un. La quinoa à les memes propriétés que le ris, elle est mucilagineuse et nourrissante. c’est peut-etre un des meilleurs aliments pour les personnes poitrinaires. c’est une plante precieuse que merite par son utilité d’etre connue et cultivée dans tous les pays. L’on fait avec la semence de quinoa une bierre connue sous le nom de chicha de quinoa. Cette boisson est une bierre sans amertume qui est diuretique, rafraichissante et nourrissante. La quinoa est bon marche à cause de sa prodigieuse fecondité, et par cette raison l’aliment des pauvres du perou et du chili. Ils retirent de cette plante precieuse leur principale nourriture et un medicament salulaire.”