

A Review of the Scientific Names of Chinese Cabbage according to the International Codes of Nomenclature

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Abstract

We organized the scientific names of Chinese cabbage according to the International Code of Nomenclature for algae, fungi, and plants (ICN) and the International Code of Nomenclature for Cultivated Plants (ICNCP). We found that the subspecies name '*Brassica rapa* subsp. *pekinensis* (Lour.) Rupr.' was suitable as the scientific name for Chinese cabbage, and we classified *B. rapa* var. *glabra* Regel. as its synonym. In addition, *B. petsai* Bailey is an 'unrecorded name' not found in the original description, and therefore is not suitable for use. We conclude that all names based on this name are 'invalid names', and should not be used.

Additional key words: *Brassica* subsp. *pekinensis*, *Brassicaceae*, ICN, ICNCP.

Introduction

According to the APG (Angiosperm phylogeny Group) III system (<http://www.mobot.org/MOBOT/research/APweb/>), the family Brassicaceae belonging to order Brassicales. Worldwide, 338 plant genera and approximately 3,700 species are known to be distributed across the temperate zones (Al-Shehbaz et al., 2006 b). Chinese cabbage is a species that, together with rapeseed (*Brassica napus* L.), mustard greens (*B. juncea* (L.) Czern.), and cabbage (*B. oleracea* L.), belongs to the genus *Brassica* L. (Warwick et al., 2006).

Chinese cabbage is one of the major vegetables produced in Korea together with radish (*Raphanus sativus* L.), red pepper (*Capsicum annuum* L.), garlic (*Allium sativum* L.), and onion (*Allium cepa* L.). In

addition to being the major ingredient in the Korean traditional food Kimchi, Chinese cabbage is widely used in the general Asian cuisines of Korea, China, and Japan in dishes such as Namul (vegetable dishes such as Saengchae, which is made with uncooked raw vegetables, and Sukchae, which is made with boiled, steamed) , stir-fries, salads, vegetable wraps, stews, and soups. Various scholars and institutions in Korea and abroad use different scientific names for Chinese cabbage, which causes confusion in the scientific literature . This confusion makes it challenging to establish and manage databases, and may introduce errors in research results.

Therefore, we examined the scientific names for Chinese cabbage that are currently in use internationally, including Korea, China, and Japan, where the largest amounts of Chinese cabbage are consumed. This study identifies the most suitable scientific name for Chinese cabbage, based on the International Code of Nomenclature for algae, fungi, and plants (ICN) (McNeill et al., 2012) and the International Code of Nomenclature for Cultivated Plants (ICNCP) (Brickell et al., 2009), in an attempt to alleviate the confusion around the nomenclature.

Status of the Scientific Name of Chinese Cabbage

Korea

The scientific name of Chinese cabbage in Korea was first recorded as *Brassica campestris* L. by Chung et al. (1937). However, *B. campestris* subsp. *napus* var. *pekinensis* (Lour.) Makino was later regarded as the correct name by various scholars (Lee, 1980; Lee, 1996; Lee, 2003; Chung et al., 2004; Lee, 2006). Among these scholars, Lee (1996) treated *Sinapis pekinensis* Lour., *B. petsai* Bailey and *B. pekinensis* (Lour.) Rupr. as synonyms . The Ministry of Environment and the Korea Forest Service recorded Chinese cabbage as *B. rapa* var. *glabra* Regel (Oh, 2007a, 2007b), while the National Academy of Agricultural Science Rural Development Administration (2009) considered *B. rapa* subsp. *pekinensis* (Lour.) Hanelt as the correct scientific name. On the other hand, Chang et al. (2014) recently classified *Sinapis pekinensis* Lour., *B. pekinensis* (Lour.) Rupr., and *B. petsai* (Lour.) L.H. Bailey as the alternative names of *B. oleracea* L., and incorporated *B. rapa* var. *glabra* Regel into *B. rapa* L.

China

Zhou et al. (2001) considered *B. rapa* var. *glabra* Regel as the correct name, and treated other scientific names as synonyms, including *B. campestris* L. subsp. *pekinensis* (Lour.) G. Olsson; *B. campestris* var. *pekinensis* (Lour.) Viehoveer; *B. chinensis* var. *pandurata* V. G. Sun; *B. chinensis* var. *pekinensis* (Lour.) V. G. Sun; *B. pekinensis* (Lour.) Rupr.; *B. pekinensis* var. *cephalata* M. Tsen & S. H. Lee; *B. pekinensis* var. *cylindrica* M. Tsen & S. H. Lee; *B. pekinensis* var. *laxa* M. Tsen & S. H. Lee; *B. pekinensis* var. *petsai* Lour.; *B. petsai* (Lour.) L. H. Bailey; *B. rapa* subsp. *pekinensis* (Lour.) Hanelt; *B. rapa* subsp. *pekinensis* var. *laxa* (M. Tsen & S. H. Lee) Hanelt; *B. rapa* subsp. *pekinensis* var. *pandurata* (V. G. Sun) Gladis; and *Sinapis pekinensis* Lour.

Japan

Tsunoda et al. (1980) organized a list of wild species belonging to the genus *Brassica*, and listed '*pekinensis* (Lour.)' under *B. rapa* without any clear explanation of the order. Al-Shehbaz et al. (2006a) considered *B. rapa* var. *glabra* Regel as the correct name, and considered *Sinapis pekinensis* Lour., *B. pekinensis* (Lour.) Rupr. as the alternative name. Ylist (<http://ylist.info/>) also considered *B. rapa* var. *glabra* Regel as the correct name, and classified *B. rapa* var. *pekinensis* (Lour.) Kitam., *B. pekinensis*

(Lour.) Rupr., and *B. rapa* var. *amplexicaulis* subvar. *pe-tsai* (L.H. Bailey) Kitam. as alternative names.

Other Countries

The Plant List (<http://www.theplantlist.org/>) classified the above-mentioned names of Chinese cabbage, including *B. rapa* subsp. *pekinensis* (Lour.) Hanelt (Mansfield, 1986), *B. campestris* L. (Linnaeus, 1753), and *B. rapa* var. *glabra* Regel (Regel, 1860), as the alternative names of *B. rapa*.

However, the majority of recent theses based on molecular genetics have classified them as subspecies names (Oh et al., 2015; Tan et al., 2015; Zhang et al., 2015; Chun et al., 2016; Lee et al., 2016; Yang et al., 2016).

Nomenclature

***Brassica rapa* subsp. *pekinensis* (Lour.) Hanelt**, Verz. Landwirtsch. Gärtner. Kulturpfl. (ed. 2) 1: 304 (1986) —Type: not designated¹ ≡ *Sinapis pekinensis* Lour., Fl. Cochinch. 2: 400 (1790) ≡ *B. pekinensis* (Lour.) Rupr., Fl. Ingr. 96 (1860) ≡ *B. campestris* subsp. *napus* var. *pekinensis* (Lour.) Makino, J. Jap. Bot. 8: 8 (1932) ≡ *B. rapa* var. *pekinensis* (Lour.) Kitam., Acta Phytotax. Geobot. 35: 125 (1984) ≡ *B. chinensis* var. *pekinensis* (Lour.) V.G. Sun, Bull. Torrey Bot. Club 73: 374 (1946) ≡ *B. campestris* subsp. *pekinensis* (Lour.) G. Olsson, Hereditas (Lund) 40: 414 (1954).

² *B. rapa* var. *glabra* Regel, Gartenflora 9: 9 (1860) —Type: “Herr Skatschkoff, Russischer Consul in China, hatte dem H. Ministerium der Domainen eine reiche Sammlung von ungefähr 500 verschiedenen Arten Chinesischer Gemüse eingesendet”.

³ *Sinapis pekinensis* var. *petsai* Lour. —unrecorded name.

– *B. petsai* (Lour.) L.H. Bailey, Cornell Univ. Agric. Exp. Sta. Bull. 67: 178 (1894) —invalid name.

– *B. chinensis* var. *petsai* (L.H. Bailey) Maire & Weiller, Fl. Afrique N. 12: 166 (1965) —invalid name.

– *B. rapa* subsp. *pekinensis* (Lour.) Kitam. —unrecorded name.

Korean name: Bae-chu (배추), Bae-chae (배채), Bae-cha (배차)

Chinese name: Bái-cái (白菜), Cǎi (菜), Dà-bái-cái (大白菜), huáng-yá-cái (黄芽菜)

Japanese name: Ha-ku-sa-i (ハクサイ, はくさい)

English name: Chinese cabbage, Kimchi cabbage, Celery cabbage

Discussion

Chinese cabbage (*B. rapa* subsp. *pekinensis*) was originally named *Sinapis pekinensis* Lour. and “Pět-fái”, which was produced in the Beijing region of China, was reported as a new species (Loureiro, 1790). Later, Ruprecht (1860) reclassified Chinese cabbage from the genus *Sinapis* to the genus *Brassica*, and gave it the new name *B. pekinensis* (Lour.) Rupr. In 1984, Kitamura classified it as a variety of *B. rapa* (turnip), and named it *B. rapa* var. *pekinensis* (Lour.) Kitam. Sun (1946) degraded it as a variety of *B. chinensis* (bok choy) and introduced the new name *B. chinensis* var. *pekinensis* (Lour.) V.G. Sun. Olsson (1954) considered it as a subspecies of *B. campestris*, and coined the name *B. campestris* subsp. *pekinensis* (Lour.) G. Olsson. By contrast, *B. petsai*, reported by Bailey (1894), is an ‘**unrecorded name**’ that has not been recorded in the original description.

¹ Nomenclatural synonym

² Taxonomic synonym

³ Illegitimate name

Therefore, it is not a usable scientific name according to the ICN (<http://www.iapt-taxon.org/>), and it is suggested that all new names based on *B. petsai* must be considered as ‘**invalid names**’, unsuitable for use.

American and European scholars classified B. campestris as the alternative name for B. rapa (Rollins, 1993; Zuloaga & Morrone, 1997; Sklenář et al., 2001; Hokche et al., 2008; Nelson, 2008; Zuloaga et al., 2008; Jørgensen et al., 2014). It is highly likely to be the same species as *B. rapa*, which originated in Europe. When compared with the lectotype of *B. campestris*, *B. rapa* subsp. *pekinensis* shows several morphological differences: the roots are thinner, the basal leaves are not arranged in rosette form, the leaf base has pinnules, and the basal leaves are smaller than the cauline leaves. Therefore, it is not desirable to incorporate the two different species into one.

The original description of B. rapa var. glabra corresponds with the morphological characteristics of Chinese cabbage, and therefore it is correct to classify it as the alternative name for B. rapa subsp. pekinensis. To ensure clarity, however, it is critical to verify the classification according to the type specimen collected by Skatschkoff.

Based on the above results, we conclude that the classification of Chinese cabbage should be at the subspecies level, and that B. rapa subsp. pekinensis (Lour.) Rupr.’ should be considered its proper scientific name.

Although methods of classification that rely on molecular genetics studies based on markers are commonly used, they are limited. Therefore, it is necessary to conduct a more extensive and accurate study based on the whole genome. Studies involving morphological and evolutionary comparisons between related genera are likely to yield accurate classifications.

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