Variations in capsaicinoid contents in the chili pepper (*Capsicum baccatum*) and its non-pungent accessions

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The chili pepper (*Capsicum*) is both an important spice and fresh vegetable worldwide. *C. baccatum* is a lesser known domesticated species that is native to the Andean region. Fruit traits such as color, shape, and pungency markedly vary in this species. *C. baccatum* has potential as a bioresource for future chili pepper breeding programs. Although extensive studies have been conducted on the pungency of *C. annuum*, that of *C. baccatum* has not been examined in as much detail. In the present study, capsaicinoid contents were analyzed in 36 *C. baccatum* accessions. Capsaicinoid contents ranged between 0 and 4,258 μg/gDW. Furthermore, a negative relationship was observed between capsaicinoid contents and fruit weights. Although the pungency of *C. baccatum* is regarded as low-mild, very few non-pungent accessions were detected; only one non-pungent accession ('Kaleidoscope') was identified among the *C. baccatum* accessions examined. In order to validate the stability of non-pungency in the accession, capsaicinoid contents were determined at different harvest dates, along with other accessions with different pungencies. Although capsaicinoid contents in other *C. baccatum* accessions changed with the picking date, capsaicinoid was not detected in 'Kaleidoscope' at any date. The non-pungent accession reported here may be useful for future *C. baccatum* pepper breeding programs.

Key words : Bio-resource; Fruit shape

Introduction

The chili pepper (*Capsicum*) is one of the most popular vegetables worldwide. In the *Capsicum* genus, there are 20-30 wild and 5 domesticated species : the latter species being *C. annuum, C. baccatum, C. chinense, C. frutescens,* and *C. pubescens*[1]. Of the domesticated species, *C. annuum* is the most widespread and popular chili pepper grown worldwide. *C. chinense* and *C. frutescens* are well known as Habanero and Tabasco, respectively. These three species are closely related and belong to the *C. annuum* complex (white flower). *C. baccatum* has white flowers with basal green/yellowish spots, while *C. pubescens* is characterized by purple flowers and black seeds. *C. baccatum* and *C. pubescens* are lesser known and their cultivation is currently confined to Latin America. These two species are called aji and rocotos, respectively, and are traditionally consumed in the Andean region[2].

Even though they are unknown worldwide, the hot peppers belonging to *C. baccatum* have been cultivated and are regarded as the most popular in Andean countries, being consumed fresh or as processed paprika. Within *C. baccatum*, there is great variation in disease resistance, and bioactive compounds such as carotenoid pigment and volatiles[2-4]. Therefore, *C. baccatum* has the potential to genetically improve peppers worldwide.

Pungency is the most unique characteristic of pepper fruits, and is caused by the lipophilic alkaloid capsaicin and its analogues, capsaicinoids[5]. The fundamental chemical structure of capsaicinoids is an acid amide of vanillylamine and a fatty acid (C9-C11). Capsaicinoids are synthesized by condensing the molecule of vanillylamine, derived from phenylalanine, to a branched fatty acid, derived from valine or leucine in placental tissue. Although more than ten capsaicinoids have been isolated to date, capsaicin and dihydrocapsaicin are the most predominant, accounting for 90% of all capsaicinoids in *Capsicum* fruits[6]. In addition to its pungent taste as a spice, capsaicinoid has beneficial pharmaceutical and medicinal applications, such as anti-cancer, anti-inflammatory, and anti-obesity treatments, as well as in pain relief[5].

Marked variations exist in capsaicinoid contents in the *Capsicum* genus. While the presence of capsaicinoids is preferred for their use as a spice or hot food, an absence or lesser amounts of capsaicinoids are desired when these peppers are used as a vegetable. Therefore, it is important to determine the composition and content of capsaicinoids in each pepper accession and select non-pungent parents for breeding programs. Many studies have been conducted on the composition of capsaicinoids and pungency in the common chili pepper (*C. annuum*) and, to a lesser extent, *C. frutescens* and *C. chinense*[7-9]. In contrast, information on the composition of capsa-

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icinoids in *C. baccatum* accessions is limited[10].

Therefore, the aims of the present study were to 1) investigate variations in capsaicinoid contents within *C. baccatum*, and 2) confirm non-pungent *C. baccatum* as a potential bioresource for future sweet pepper breeding programs. We evaluated capsaicinoid contents and morphological traits in 36 *C. baccatum* accessions, and subsequently selected one non-pungent accession. We also characterized the stability of its non-pungency and compared it with other *Capsicum* accessions.

Materials and Methods

HPLC analysis for capsaicinoid contents

Three immature fruits approximately 30 days after flowering were used to determine capsaicinoid contents. Fresh fruits were lyophilized using a freeze drier for 3 days, and then ground in a blender. Capsaicinoids were extracted from 200 mg of dry fruit powder in 4 mL acetone. The supernatant was poured into a 1.5-mL tube through a filter (DISMIC 13HP, ADVANTEC) and then used in an HPLC analysis.

The HPLC analysis was performed using the JASCO PU-2080 Plus pump equipped with the UV-Vis detector SPD-10A (Shimadzu, Kyoto, Japan) and Shimadzu CR-6A integrator. Separation was performed on an Inertsil ODS-3 column (250×4.6 mm i.d.). The eluent was a mixture of methanol/water (75:25) at a flow rate of 1.0 mL/min. The UV-Vis detector was set at 280 nm. The injection volume, run time, and temperature were 10 μL, 30 min, and 40℃, respectively. Capsaicinoid contents were calculated as the sum of capsaicin and dihydrocapsaicin. Standard mixtures of capsaicinoids (Merck) were used for retention time verification and quantification by HPLC.

Experiment 1 : Fruit shapes and capsaicinoid contents in C. baccatum accessions

As shown in Table 1, 36 *C. baccatum* accessions were used. All plants were grown at the experimental farm of Okayama University (lat. 34° 68′ N, long. 133° 91′ E) in 2013 and 2014. Three seedlings per accession were transplanted to the field in May and June. Nine fully mature fruits of each accession were harvested from three plants, and morphological characteristics (fruit length, width, and weight) were recorded. Capsaicinoid contents were determined in each accession as described above.

Experiment 2 : Stability analysis of capsaicinoid contents at different harvest dates

In order to investigate the stability of capsaicinoid contents in one non-pungent *C. baccatum* accession, these contents were determined at different harvest dates. One pungent ('Arivivi'), 2 low-pungent ('Aji Cito', 'Bishop Cap'), and 1 non-pungent ('Kaleidoscope') *C. baccatum* accessions were selected. As a reference for *C. baccatum* accessions, three *C. annuum* cultivars ('Takanotsume', 'Shishitou', and 'Kyo-midori') were also used. This experiment was conducted at the same location as experiment 1 between May and Oct. 2014. Three seedlings per accession were transplanted in May to the open field. These plants were spaced at 40 cm between plants and 80 cm between rows. Standard horticultural practices for pepper production were followed. Fertilization was applied using a slow release fertilizer. Phytosanitary treatments against insects were performed when necessary. Nine immature fruits of each accession were harvested from three plants every two weeks (2014 7/17, 8/4, 8/18, 9/1, 9/15, 9/30, and 10/15),

Table 1 Variations in fruit morphological traits of *Capsicum baccatum*

Accession	Fruit length (mm)	Fruit width (mm)	L/W[a]	Fruit weight (g)
PI 260567	18.7 ± 0.50[b]	10.0 ± 0.25	1.87	0.8 ± 0.04
Aji Russian Yellow	64.9 ± 3.07	15.5 ± 0.52	4.18	4.8 ± 0.51
Pea	16.2 ± 0.74	18.1 ± 0.33	0.90	2.6 ± 0.19
Arivivi	16.8 ± 1.00	7.8 ± 0.50	2.15	0.6 ± 0.08
Super	24.3 ± 0.84	15.5 ± 0.36	1.57	2.0 ± 0.10
Lemon Drop	60.3 ± 1.72	16.5 ± 0.48	3.65	4.7 ± 0.31
Queen Laury	61.5 ± 1.89	25.6 ± 1.16	2.40	13.0 ± 1.15
Bird Aji	11.6 ± 0.11	10.4 ± 0.27	1.13	0.8 ± 0.04
Aji Cereo	32.3 ± 0.91	20.8 ± 1.41	1.55	5.3 ± 0.60
Deciduous-1	24.0 ± 1.10	16.0 ± 0.90	1.50	2.2 ± 0.22
Jamy	58.4 ± 1.21	31.8 ± 0.64	1.84	16.3 ± 1.19
Rain Forest	45.3 ± 2.14	43.4 ± 1.16	1.04	19.5 ± 1.05
Chaco Yellow	30.3 ± 0.77	10.4 ± 0.35	2.91	1.4 ± 0.10
Exploding Fire	19.3 ± 1.30	8.5 ± 0.39	2.28	0.8 ± 0.09
Aji Colorado	116.0 ± 3.48	19.2 ± 0.55	6.04	12.1 ± 0.85
Heart Throb	21.5 ± 0.89	19.7 ± 0.17	1.09	3.5 ± 0.10
Omnicolor	51.8 ± 2.50	16.1 ± 0.42	3.22	3.9 ± 0.25
No3188	26.0 ± 0.76	12.7 ± 0.38	2.05	1.6 ± 0.13
Benito	37.5 ± 1.82	24.8 ± 0.71	1.51	7.0 ± 0.43
Paraguay Red	24.9 ± 1.20	19.9 ± 0.70	1.25	3.5 ± 0.38
Bolivian Marble	16.1 ± 0.50	18.7 ± 0.50	0.86	2.6 ± 0.14
Criolla sella	45.7 ± 1.59	14.4 ± 0.37	3.17	4.7 ± 0.29
Brazilian Starfish	17.5 ± 0.48	32.4 ± 1.20	0.54	6.4 ± 0.58
Francos Aji	102.4 ± 5.04	29.9 ± 0.48	3.43	24.9 ± 1.68
Brazilian Pumpkin	19.0 ± 0.33	32.9 ± 0.63	0.58	9.5 ± 0.33
Bode Laranja	17.4 ± 0.38	21.8 ± 0.89	0.80	3.3 ± 0.24
Aji Norteno	86.8 ± 2.83	31.5 ± 1.00	2.76	19.6 ± 1.16
Aji Golden	88.4 ± 2.64	22.6 ± 0.69	3.91	14.9 ± 0.75
Aji Amarillo	112.0 ± 6.10[y]	28.5 ± 1.39	3.93	20.5 ± 1.81
UFO	40.1 ± 0.90	48.7 ± 1.50	0.82	13.3 ± 0.67
Amarillo	49.2 ± 2.59	27.4 ± 1.12	1.79	10.7 ± 1.17
Aji Angelo	77.1 ± 2.05	31.3 ± 1.17	2.47	19.6 ± 0.92
Aji Habanero	56.0 ± 2.21	21.5 ± 0.56	2.60	8.1 ± 0.36
Aji Cito	47.9 ± 1.47	16.7 ± 0.58	2.87	4.1 ± 0.32
Bishop Cap	36.8 ± 1.60	53.8 ± 3.30	0.68	19.5 ± 2.63
Kaleidoscope	68.2 ± 3.30	23.2 ± 0.80	2.94	10.1 ± 0.69

a) Fruit length/ Fruit width
b) Means ± standard error (n = 9)

and fruit weights were recorded. Capsaicin and dihydrocapsaicin contents in mature fruits were determined by HPLC as described above. The HPLC analysis was performed with 3 replicates for each harvest date. The monthly average temperatures during the experiment were 23.8℃ (Jun.), 27.6℃ (Jul.) 26.9℃ (Aug), 23.8℃ (Sep.), and 18.4℃ (Oct), respectively.

Results and Discussion

Variations in fruit shapes

Fruit morphology, such as size and shape, varied widely in *C. baccatum*. Fruit length averaged 45.6 mm with a range of 11.6 mm ('Bird Aji')–116.0 mm ('Aji Colorado'). Average fruit width was 22.7 mm with a range of 7.8 mm ('Arivivi')–53.8 mm ('Bishop Cap'). Fruit weight averaged 8.3 g and ranged from 0.6 g ('Arivivi')–24.9 g ('Francos Aji'). Twenty-nine out of 36 accessions were elongated with an L/W ratio larger than 1.0. These ranges in fruit shapes and weights were consistent with previous findings reported by Jarret (2007)[11], who evaluated the morphological characteristics of 295 *C. baccatum* accessions and showed that fruit length averaged 60.1 mm with a range of 8.0–160.0 mm, average fruit width was 18.6 mm and ranged from 5.0–47.5 mm, and average fruit weight was 5.9 g with a range of 0.15–22.8 g. Furthermore, more than 90% of accessions had elongated fruits with an L/W ratio greater than 1.0.

Variations in capsaicinoid contents

The total capsaicinoid content was determined as the sum of capsaicin and dihydrocapsaicin by an HPLC analysis. The total capsaicinoid content in the *C. baccatum* accessions varied widely. The average total capsaicinoid content of 36 accessions was 1,381 µg/gDW and ranged between 0 and 4,258 µg/gDW (Table 2). The highest capsaicinoid content was found in PI 260567 with 4,258 µg/gDW of total capsaicinoid and a composition of 64.1% capsaicin. The capsaicinoid content range in very pungent *C. baccatum* accessions was approximately 3,000 µg/gDW to 4,000 µg/gDW, which was equivalent to that of the typical pungent cultivar 'Takanotsume' (3,833 ± 899 µg/gDW n = 3). These contents were less than that of the well-known high pungent *C. chinense* cultivar 'Red Habanero' (15,008 ± 786 µg/gDW n = 3). The capsaicinoid contents in low-pungent accessions were 131 µg/gDW and 37 µg/gDW, with only 'Kaleidoscope' showing a complete absence of capsaicinoids.

Capsaicin and dihydrocapsaicin were detected in all accessions, except for the non-pungent accession 'Kaleidoscope'. The ratio of capsaicin and dihydrocapsaicin varied widely in *C. baccatum* accessions, ranging between 11% and 80%. Most accessions contained higher amounts of capsaicin than dihydrocapsaicin, except for 'Super', 'Bode Laranja', and 'Bishop Cap'.

Table 2 Capsaicin, dihydrocapsaicin, and total capsaicinoid contents in *Capsicum baccatum*

Accession	Content (µg/gDW)			CAP ratio[a]
	Capsaicin	Dihydrocapsaicin	Total capsaicinoid	
PI 260567	2,730 ± 320.3[b]	1,528 ± 84.6	4,258 ± 398.1	64.1
Aji Russian Yellow	2,512 ± 185.9	1,002 ± 73.1	3,513 ± 145.5	71.4
Pea	2,548 ± 328.5	815 ± 52.7	3,363 ± 311.2	75.7
Arivivi	2,291 ± 503.1	830 ± 124.3	3,121 ± 625.4	73.4
Super	1,510 ± 102.0	1,552 ± 69.6	3,062 ± 169.6	49.3
Lemon Drop	2,037 ± 556.9	877 ± 157.4	2,914 ± 708.1	69.8
Queen Laury	1,780 ± 234.5	1,010 ± 125.6	2,789 ± 359.3	63.8
Bird Aji	1,367 ± 136.4	930 ± 61.1	2,296 ± 197.1	59.5
Aji Cereo	1,379 ± 477.8	686 ± 342.5	2,065 ± 820.2	66.7
Deciduous-1	1,123 ± 115.7	773 ± 54.2	1,896 ± 163.0	59.2
Jamy	1,115 ± 375.8	439 ± 144.3	1,554 ± 520.1	71.7
Rain Forest	1,001 ± 149.8	518 ± 67.3	1,519 ± 217.1	65.9
Chaco Yellow	1,029 ± 82.7	441 ± 64.2	1,469 ± 146.9	70.0
Exploding Fire	863 ± 47.6	560 ± 48.2	1,423 ± 93.5	60.6
Aji Colorado	1,089 ± 82.9	332 ± 44.0	1,421 ± 124.3	76.6
Heart Throb	994 ± 253.4	290 ± 68.1	1,283 ± 321.5	77.4
Omnicolor	703 ± 167.4	561 ± 122.4	1,264 ± 288.8	55.6
No3188	800 ± 38.3	380 ± 13.7	1,179 ± 52.0	67.8
Benito	748 ± 150.9	222 ± 9.6	970 ± 160.3	77.0
Paraguay Red	494 ± 103.8	393 ± 64.3	887 ± 167.1	55.7
Bolivian Marble	547 ± 60.3	276 ± 25.4	823 ± 85.8	66.5
Criolla sella	661 ± 178.6	161 ± 55.7	822 ± 234.1	80.3
Brazilian Starfish	473 ± 93.5	301 ± 14.1	774 ± 106.4	61.0
Francos Aji	528 ± 217.1	230 ± 85.7	758 ± 299.1	69.6
Brazilian Pumpkin	479 ± 50.7	223 ± 21.9	702 ± 72.4	68.2
Bode Laranja	317 ± 46.5	335 ± 36.9	652 ± 82.1	48.6
Aji Norteno	403 ± 102.8	237 ± 45.9	640 ± 147.9	62.9
Aji Golden	350 ± 73.5	131 ± 21.2	481 ± 94.7	72.8
Aji Amarillo	284 ± 226.5	180 ± 111.5	464 ± 337.7	61.2
UFO	245 ± 86.0	151 ± 47.7	396 ± 133.5	61.8
Amarillo	181 ± 30.2	129 ± 10.5	310 ± 33.5	58.4
Aji Angelo	213 ± 36.9	93 ± 16.8	305 ± 53.5	69.6
Aji Habanero	137 ± 40.2	52 ± 12.3	189 ± 52.5	72.4
Aji Cito	78 ± 34.6	52 ± 17.2	131 ± 51.6	59.9
Bishop Cap	4 ± 1.5	33 ± 5.7	37 ± 5.7	11.0
Kaleidoscope	nd.[c]	nd.	nd.	–

a) CAP ratio = capsaicin content/total capsaicinoid content
b) Means ± standard error (n = 3)
c) nd. = not detected

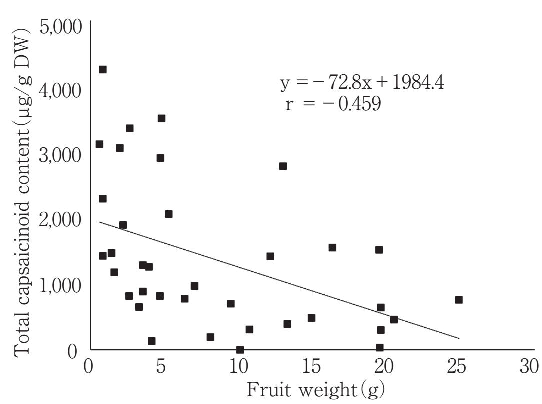

Fig. 1 Relationship between fruit weights and capsaicinoid contents in *Capsicum baccatum* accessions

Table 3 Capsaicinoid contents in *Capsicum baccatum* and *Capsicum annuum* accessions at different picking dates

Species	accession	picking date 7/17	8/4	8/18	9/1
C. baccatum	Arivivi	3,772.5 ± 88.53 a [a]	3,813.1 ± 298.12 a	2,520.5 ± 91.34 ab	1,896.6 ± 228.44 b
	Aji Cito	307.1 ± 182.39 a	159.4 ± 118.21 a	70.8 ± 40.16 a	263.8 ± 90.08 a
	Bishop Cap	– [b]	17.9 ± 12.99 a	5.9 ± 5.89 a	36.2 ± 36.22 a
	Kaleidoscope	nd. [c]	nd.	nd.	nd.
C. annuum	Takanotsume	2,468.5 ± 381.53 a	2,647.9 ± 1,184.07 a	2,565.9 ± 784.90 a	2,415.6 ± 1,143.53 a
	Shishitou	2,502.2 ± 270.15 a	195.1 ± 43.53 b	486.6 ± 238.35 b	390.2 ± 222.03 b
	Kyo-midori	nd.	nd.	nd.	nd.

Species	accession	picking date 9/15	9/30	10/15
C. baccatum	Arivivi	1,097.6 ± 100.74 b	2,619.4 ± 281.30 ab	2,692.2 ± 91.10 ab
	Aji Cito	85.7 ± 58.83 a	84.0 ± 23.29 a	30.2 ± 24.12 a
	Bishop Cap	46.6 ± 19.31 a	39.3 ± 8.18 a	26.8 ± 8.43 a
	Kaleidoscope	nd.	nd.	nd.
C. annuum	Takanotsume	3,036.7 ± 1,131.27 a	3,833.9 ± 635.89 a	2,022.5 ± 1,093.98 a
	Shishitou	451.1 ± 209.05 b	379.1 ± 111.55 b	384.8 ± 267.20 b
	Kyo-midori	nd.	nd.	nd.

a) Means ± standard error (n = 3) Different letters within accessions indicate significant differences at $P<0.05$ by the Tukey HSD test.
b) fruits were not obtained
c) nd. = not detected

'Bishop Cap' showed the lowest proportion of capsaicin at 11% with a low total capsaicinoid content.

A correlation analysis between fruit morphological characteristics and pungency revealed a negative correlation ($r = -0.45$, $P<0.01$) between fruit weights and total capsaicinoid contents (Fig. 1), indicating the domestication of large non-pungent fruit genotypes from smaller pungent fruit types.

The stability of non-pungency in 'Kaleidoscope'

Out of the *C. baccatum* accessions, 'Kaleidoscope' was selected as the non-pungent candidate accession. Previous studies have demonstrated however that environmental factors such as temperature, light, water stress, and soil nutrients affect capsaicinoid production. For example, 'Shishitou' is categorized as a sweet and small fruit pepper, but has been shown to produce pungent fruit under high light intensity and temperature conditions[12,13]. Murakami et al. (2006) demonstrated that 'Shishitou' produced more capsaicinoids under continuous fluorescent light and temperature (150-350 μmol・m^{-2}, 28℃) than that of plants grown under an 18-hr/6-hr (light/dark) cycle with a temperature of 28/20℃ cycles[14]. When non-pungency is unstable, i.e. capsaicinoid biosynthesis occurs under certain environmental conditions, it is difficult to utilize this accession as a sweet pepper. In order to validate the stability of capsaicinoid contents in *C. baccatum*, we selected 4 *C. baccatum* and 3 *C. annuum* accessions as references with different pungencies. Changes in total capsaicinoid contents and morphological characteristics were recorded at different harvest dates. No significant changes were observed in fruit weights in any accession (data not shown). 'Arivivi' and 'Takanotsume' showed high capsaicinoid contents in this experimental term. In 'Takanotsume', capsaicinoid contents ranged between 2,022 and 3,833 μg/gDW at different harvest dates, with no significant differences being observed (Table 3). In 'Arivivi', although capsaicinoid contents decreased significantly on 9/1 and 9/15, it had consistently high capsaicinoid contents. 'Shishitou' had pungent fruits through this experimental term. Wide fluctuations were noted in capsaicinoid contents between 195 μg/gDW and 2,502 μg/gDW, which was consistent with previous findings[14]. A relationship was not observed between capsaicinoid contents and air temperatures. 'Aji Cito' and 'Bishop Cap' had small amounts of capsaicinoids, ranging from 30 to 307 μg/gDW and 5 to 46 μg/gDW, respectively. On the other hand, the bell-type pepper 'Kyo-midori' stably showed no pungency at any harvest date. 'Kaleidoscope' also constantly had non-pungent fruits and capsaicinoids were not detected in its fruits (Table 3). Therefore, 'Kaleidoscope' may be regarded as a stable non-pungent accession. To the best of our knowledge, this is the first study to investigate non-pungency in *C. baccatum*.

The absence or small amount of capsaicinoids is one of the most essential characteristics of sweet pepper fruits. Previous studies have been conducted on the genetic factors controlling capsaicinoid contents. A loss-of-function mutation in *pun1* has been identified as a genetic factor leading to non-pungency. *Pun1* encodes an acyltransferase that acylates vanillylamine with a fatty acid to produce capsaicinoids in pepper fruits[15]. To date, three loss-of-function alleles have been identified in *C. annuum, C. chinense,* and *C. frutescens*[16]. *pAMT* has also been identified as a genetic factor that reduces capsaicinoid contents[17]. *pAMT* encodes aminotransferase, which produces vanillylamine, a precursor of capsaicinoid, from vanillin. Eight *pamt* alleles have been identified in the *C. annuum* complex to date[18,19]. Therefore, pepper breeding for non-pungency is feasible with the introduction of the loss-of-function *pun1* or *pamt* alleles. In addition, No. 3341 (*C. chinense*) has been identified as a non-pungent bioresource with an unknown genetic mechanism[20].

Although genetic research on non-pungency in the *C. annuum* complex has advanced, that on non-pungent *C. baccatum* accessions has not. Since difficulties are associated with interspecific crossing between the *C. annuum* complex and *C. baccatum* due to post-fertilization genetic barriers[21,22], the identification of non-pungent accessions in *C. baccatum* will be important for its breeding. 'Kaleidoscope' in this study will be useful for the development of sweet peppers in *C. baccatum*.

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トウガラシ（*Capsicum baccatum*）における カプサイシノイド含量の変異とその非辛味系統

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トウガラシ（*Capsicum* 属）は世界的に重要な香辛料および野菜である．*C. baccatum* は南米原産のマイナーな栽培種であるが，果色，果形や辛味など果実形質に多様性が認められることから，トウガラシ遺伝資源として注目されている．トウガラシの辛味性については *C. annuum* 種において多くの研究が行われているが，*C. baccatum* 種においては十分研究されていない．

本研究では，*C. baccatum* 36系統について辛味成分カプサイシノイドの含量を調査した．カプサイシノイド含量の幅は０～4,258 μg /gDW であった．また果実重と辛味成分含量の間に負の相関が認められた．*C. baccatum* の辛味は低～中程度であるが，非辛味系統はほとんど認められず，唯一１系統（‘Kaleidoscope’）が非辛味であった．この非辛味の安定性を調査するために，辛味程度の異なる系統とともに異なる収穫時期におけるカプサイシノイド含量を調査した．

他の *C. baccatum* 系統ではカプサイシノイド含量は収穫時期で変化したが，‘Kaleidoscope’ ではいずれの収穫時期でもカプサイシノイドは検出されなかった．本研究で見出された非辛味系統は将来の *C. baccatum* の育種において有用であろう．

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