CHILI PEPPERS IN BHUTAN

ICHIRO FUKUDA

(Received January 8, 1993)

Bhutan is situated in the eastern Himalaya mountain region (about north latitude, 27.5°– east logitude, 90.5°). The main towns—Paro, Thimphu and Punakha—are located 1500–2500 meters above sea level.

When we visited Bhutan in the autumn of 1991, we saw paddy fields of red rice and white rice spread like a yellow and brown carpet in the Paro, Thimphu and punakha valleys (Fig. 1). We also saw bright red objects on the roof of each farmer's house (Fig. 2). What were they? They placed to be chili peppers, which farmers were drying them. We found that a lot of chili peppers were growing in their fields (Fig. 3). We also saw the wealth of a red chili peppers at farmer's first floor store room (Fig. 4). We heard that Bhutan exports these chili peppers to India.

a. Characteristics of Bhutan chili peppers

The Bhutan chili peppers belong to *Capsicum annuum* L. They have large, long bright-colored fruits. I have investigated Japanese, Korean, Nepalease, Indian and Chinese chili peppers in the Asian region for several years (Fukuda, 1984), but I had never seen such big and beautiful chili peppers in that regions.

During my stay in Bhutan in September–October, 1991, I collected *Capsicum* materials from several spaces at different high elevation in Bhutan.

Fig. 1. The paddy field of a yellow and brown carpet in Paro valley, Bhutan.

Fig. 2. Chili peppers (showing by arrow mark) on the roof of each farmer's house at Joeshin Gonpa, Bhutan.

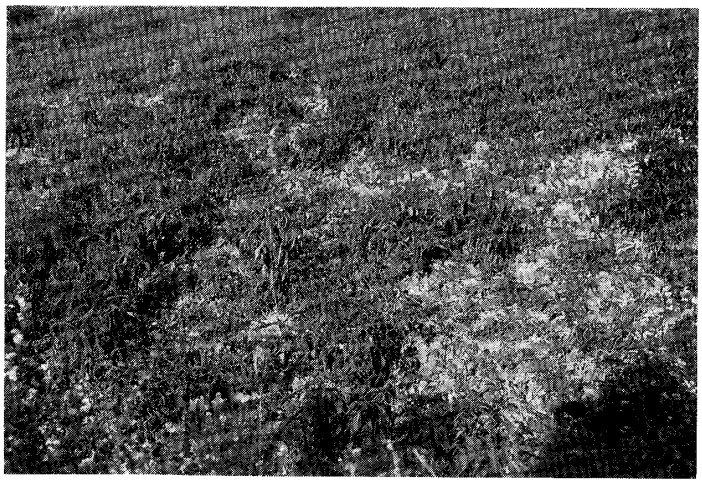

Fig. 3. The field of chili peppers at Menju (elevation, 2360 m), Bhutan. October 1991.

b. Electrophoresic experiments on Bhutan chili peppers

After I returned to Japan I attempted isozyme analysis using electrophoresis with my students of Tokyo Woman's Christian University, Tokyo. The sample materials were fresh fruits containing seeds (100 mg) from each place in Bhutan. They were smashed with an extract solution (potassium phosphate buffer, 0.05 M, pH 7.0). After centrifugation by means of a disposable microcentrifuge tube for 10 minutes, crude extracts of the sample were put in thin-layer acrylamide gel. Thin-layer acrylamide-gel sections ($1 \times 140 \times 140$ mm) were used for the subsequent electrophoresic experiments. Twelve colums ($1 \times 4 \times 15$ mm) were prepared and extract samples were placed in the colums using micropipet. The electrode solution consisted of 0.02 M HCl and 0.02 M ethylenediamin. The electrical conditions were 30 mA, and 500 volts for 120 min-

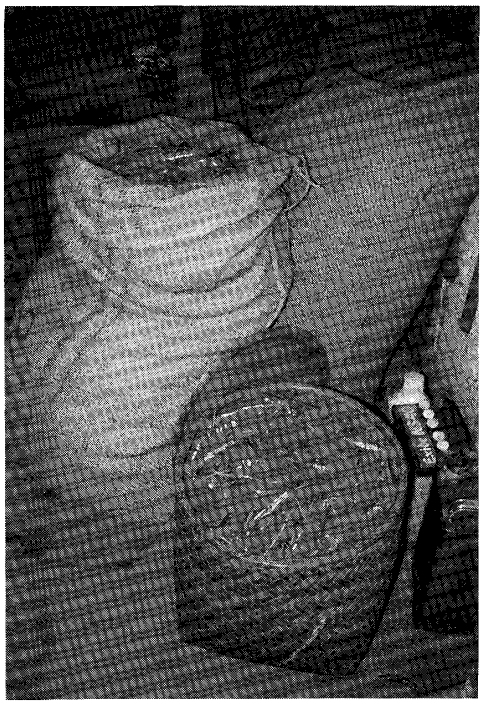

Fig. 4. The wealth of a red chili pepper harvested, at the farmer's house of Joeshin Gonpa, Bhutan.

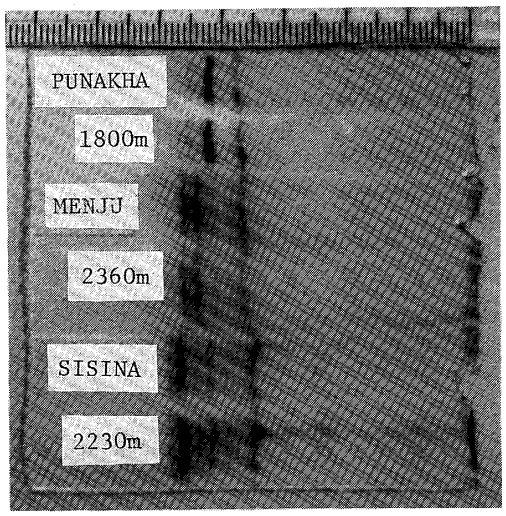

Fig. 5. Chili peppers from Punakha, Menju and Sisina in Bhutan.

utes. As the dye solution for staing of the Esterase enzyme we used fast blue RR salt in a $Na_2HPO_4 \cdot 12H_2O$, $KHPO_4$ solution (1/15 M phosphate buffer, pH 7.0). The substrate buffer was a mixture of α-naphtyle acetate and aceton. The gel was soaked for one minute in the staining buffer before being placed in the substrate buffer. The peroxidase activity was stopped by the use of 7% acetic acid.

c. Genetic variation in the Bhutan chili pepper

Fig. 5 shows the findings on the peroxidase bands of the Esterase enzyme for the *Capcicum annuum* materials examined. It is of great interest that the materials from punakha, Menju and Sisina show obviously different bandings. They have almost the morphlogical characters but show genetical variations (Fig. 6). The plants from Punakha (elevation 1800 m) have two bands, those from Menju (2360 m), three bands, and those from Sisina (2230 m), five bands. It seems that the chili pepper plants in Bhutan have been differentiated by adaptation for high elevations, for the *Capsicum* species usually show the same banding pattern in the same area.

d. The origin of the Bhutan chili pepper

How did Bhutan's chili pepper, which shows such variable genetical characteristics, develop? Before we consider this question we need to know that the chili pepper originated in the New World. All species of *Capsicum* are American in origin and were unknown to benifit before

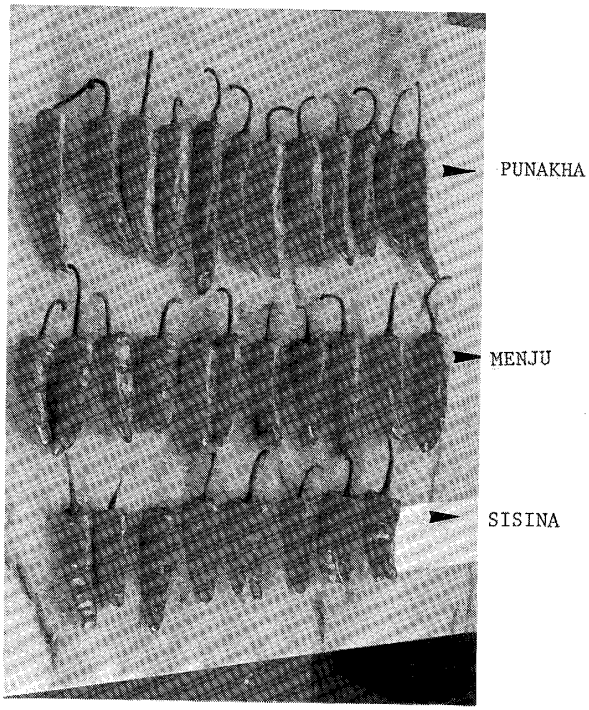

Fig. 6. The Esterase banding phenotypes of chili peppers from Punakha, Menju and Sisina.

1494, when Chanca, the physician to the fleet of Columbus on his second voyage to the West Indies, briefly described their use by the natives. "Food and Drinks in Ancient India" by Om Prakash, mentions no use of chili peppers by ancient Indian.

In 1542 "De Historia Stirpium Commentarii Insignes", by Leonhart Fuchs, described the chili pepper species of Europe, which was introduced from the American continent. In 1593, Garcia da Orta described how the American–European chili pepper have already been dispersed in Calicut, India and the Moluccas islands in Asia.

Therefore, the history of the chili pepper has been only four hundred years in Asia. Especially the people of the Himalayan mountain region were introduced slowly the chili pepper. (In 1605 chili peppers and tobacco, were introduced into Japan through Lisbon, Portugal.)

Where then was Bhutan's chili pepper introduced from? Bhutan is landlocked and lies between its giant neighbors, India and China. Probably it seems that the chili peppers were introduced from India at first. However, we cannot now find the large and bright red chili pepper of Bhutan in any part of India. As a result of my collections from China, Korea, and the southeastern Asian countries I found the same type of *Capsicum annuum* as Bhutan at last at Sekirin, Yunnan in China. Although Sekirin and Bhutan are far separated, the Hani nationality living and eating the chili pepper in Sekirin and the Drukpa nationality living and eating the chili pepper in Bhutan both originated from Tibetan. It seems that, at first, the Hani people got the *Capsicum* species from European pepple because they were active commercially, and sometime later the Hani people must have given it to the Bhutan people.

Fig. 7 shows the findings on the peroxidase bands of the Esterase enzyme for the *Capsicum annuum* materials in China and Bhutan, as examined by the same method as was used for the electrophoresis. The bands from Punakha, Bhutan, and Sekirin, China are the same, but the others from China are different. This indicates some kind of trade

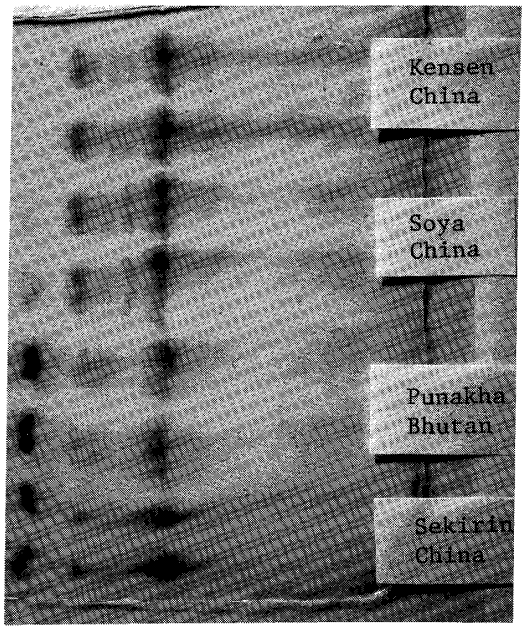

Fig. 7. The Esterase banding phenotypes of chili peppers from China and Bhutan.

in food between races in different countries.

e. The cooking of Bhutan using chili peppers

Farmers of Bhutan eat three times a day. Mothers get up at 6 : 00 a. m. and prepare breakfast by 7 : 00 a. m.. This breakfast, called IZEE, consists of toh (boiled rice), chili pepper-cheese, and freshe vegetables with butter tea. The lunch (12 : 00 a. m.), called EMMA-DACHI consists of toh and boiled vegetables with chili peppers and butter-cheese. The supper or dinner, called EMADA-DACHI or PAE (7 : 00 p. m.) consists of toh and pork, beef or checken, pulus vegetables and chili peppers. They thus use a lot chili peppers are the most important foods supplemented with milk and meat. They do not use fermented food as the Japanese do.

The Bhutan people live in a mountainous region from 1800 m to 2600 m above sea level. Both the rice and the chili peppers are cultivated at the elevation of up to 2600 m. These are the highest cultivated recored in Asia. The Drukpa people were originally a nomadic tribe in the grassland hill of Tibet; when they encountered rice and chili peppers it made for a dramatic change in their meal customs.

Acknowledgements

This research was carried out in 1991 with the support of a scientific grant for overseas research from the Ministry of Education, Science and Culture, the Japanese Government (Grant No. 03041077). Dasho Pema Wangchhuk, Secretary Minister and Dasho Kinzang Dorji, Director General, Department of Agriculture of the Royal Bhutan Government, Guide Soma Dorji and Peter Santa helpted us during our stay in Bhutan in September–October in 1991. We would like to express our heartfelt appreciations for the above authorities and persons. I also wish to thank Dr. Clare L. Colegrove, Prof. of Tokyo Woman's Christian University, for checking this English manuscript.

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