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Study of acaroid mites pollution in stored fruit-derived Chinese medicinal materials

Li-fa Xu[1], He-xia Li[1], Peng-fei Xu[1], Hai-feng Xu[1] and Chao-pin Li[1]

[1]*School of Medicine, Anhui University of Science & Technology, 232001 Huainan, China.*

Abstract

Objective: **to investigate the species and breeding density of acaroid mites in stored fruit-derived Chinese medicinal materials in Anhui province.**

Methods: **samples of stored fruit-derived Chinese medicinal materials were collected from 30 herb stores and storehouses in 17 Anhui cities, where the breeding acaroids mites were detected.**

Results: **20 species of acaroids mites were found in 33 samples, belonging to 15 genus, 5 families of the acaridae respectively, among which *T. putrescentiae*, *A. farinae*, *C. lactis*, and *C. berlesei* are predominant species.**

Conclusion: **stored fruit-derived Chinese medicinal materials in Anhui areas suffer from serious acaroid mites pollution. Therefore, proactive measures should be taken to control acaroid mites from breeding in an effort to reduce the harm on medicinal materials.**

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Key words: *Stored fruit-derived Chinese medicinal materials. Acaroid mites. Habitat. Allergic diseases. Anhui province.*

ESTUDIO DE LA CONTAMINACIÓN POR ÁCAROS EN PRODUCTOS MEDICINALES CHINOS ALMACENADOS DERIVADOS DE LA FRUTA

Resumen

Objetivo: **investigar las especies y la densidad de reproducción de ácaros en productos medicinales chinos almacenados derivados de la fruta en la provincia de Anhui.**

Métodos: **muestras de productos medicinales chinos almacenados derivados de la fruta fueron recogidos a partir de 30 herbolarios y almacenes en 17 ciudades de Anhui, donde se detectó la reproducción de ácaros.**

Resultados: **se detectaron 20 especies de ácaros en 33 muestras, pertenecientes a 15 géneros, 5 familias de ácaros respectivamente, entre los cuales *T. putrescentiae*, *A. farinae*, *C. lactis* y *C. berlesei* son las especies predominantes.**

Conclusión: **los productos medicinales chinos almacenados derivados de la fruta en la zona de Anhui sufren una grave contaminación por ácaros. Por lo tanto, se deben tomar medidas dinámicas para controlar la reproducción de ácaros en un esfuerzo por reducir los daños en los productos medicinales.**

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Palabras clave: *Productos medicinales chinos almacenados derivados de la fruta. Ácaros. Hábitat. Enfermedades alérgicas. Provincia de Anhui.*

Allergic disease is recognized by WHO as one of the four major non-infectious diseases that deserve top priority in prevention and treatment in the 21st century. With an overall incidence of 10%~30%, global allergic disease has become a big worldwide issue of public health[1,2]. Allergen is one of the important factors that bring about allergic diseases and mite allergen is considered to be a major one[3-6]. As an aspiration allergen widely extant in nature, mite allergen has long received special attention for its universality and particularity[7-10]. Therefore, it's of great significance in the prevention and treatment of allergic asthma to investigate acaroid mites in different habitats and stores. From November 2009 to November 2011, this laboratory investigated breeding acaroid mites in 33 species of stored fruit Chinese medicinal materials, which were collected from 30 herb stores and storehouses in 17 Anhui cities. Here's the report.

Correspondence: Chao-Pin Li.
School of Medicine, Anhui.
University of Science & Technology.
Huainan, Anhui 232001, China.
E-mail: cpli001@126.com

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Material and Methods

Sample Collection

According to the breeding habit of acaroid mites, herb stores and storehouses were investigated and ecological instruments were used to get relevant information; at the same time, fruit Chinese medicinal materials sold in herb stores or stored in storehouses were sampled, mainly including: *Crataegus pinnatifida Bunge, Ligustrum lucidum Ait, Chaenomeles sinensis (Thouin) Koehne,fructus choerospondiatis, ZizyPhus sPinosus Hu, Ziziphus zizyphus, FRUCTUS LYCII, Rubus idaeus* and so on. Apart from that, dust in the investigated places were also sampled. The storage period of all the samples should at least 6 months. Each kind of fruit Chinese medicinal materials is collected in 10 samples and each sample should be weighed on the scale to make sure it's 10 gram. All samples were sealed in sampling bags separately to be carried back to the laboratory. Shakesieve shock is adopted to separate the sample into material object and dust.After this was done, acaroid mites were detected out.

Separation and Classification of Acaroid Mites

Airecticopy and Tullgren was adopted to separate acaroids mites from material object while waternacopy was used to separate those from the dust[11]. With reference to methods mentioned in the previous literature[12], slide specimen were made with the acaroid mites separated from the samples. Under the light microscope, the mites were identified and counted after their morphological characteristics were observed. Their species were classified in Hughes(1976)'s classification system[13].

Information Analysis

The number of acaroids mites in different samples of stored material was counted, and the breeding density of acaroid mites was calculated in accordance with the formula (D=N/T×100%) (N is the number of acaroid mites, T is the sample quality, and D is the breeding density of acaroid mites); the richness index of species was shown in Margalef index, Rmargalef=(S-1)/lnN (S is the number of species, N is the total number of every individual species); the diversity index of species was shown in Shannon-Wiener index, H'=-ΣPilnPi) (Pi=Ni/N, or the probability that the 1st individual belongs to the ith species); index the evenness index of species was shown in Pielou index, that is, J=H'/Hmax (Hmax =lnS).

Results

Species and Density of Acaroid Mites in Different Dry Fruit Samples

Species and density of acaroid mites in 33 kinds of fruit Chinese medicinal materials are shown in table I, which demonstrates that different species of acaroids mites differ in ecological habits and habitats. We can also see that the breeding density of acaroids mites differ greatly in different dry fruits, and that they breed in a wide range of dry fruits. 20 species of acaroid mites were separated from 33 kinds of fruit Chinese medicinal materials, belonging to 15 genus and 5 families of the acaridae respectively, as is shown in table II. The results show that acaroid mites breeding in stored fruit Chinese medicinal materials of Anhui area are wide in species.

Ecological Parameters of Acaroid Mites in Chinese fruit-derived medicinal materials

Among the 33 samples of different Chinese fruit-derived medicinal materials, *Ligustrum lucidum Ait*, *FRUCTUS LYCII*, *Castanea mollissima*, *Solanum mammosum L*, and *Actinidia chinensis* rank the top five successively in terms of breeding density of acaroids mites. The breeding density, number of species, richness index, diversity index, and evenness index are shown in table III, which demonstrates that different species of acaroids mites differ in ecological habits and habitats. The highest breeding density is in *Ligustrum lucidum Ait*, while the highest richness index, diversity index and evenness are all in *Castanea mollissima*. From the table IV we can conclude that stored Chinese fruit-derived medicinal materials suffer from serious acaroid mites pollution, with a diverse species and a relatively stable species class.

Seasonal Changes of Acaroid Mites in Chinese fruit-derived medicinal materials

Seasonal Changes of 33 Species of Chinese fruit-derived medicinal materials

In light of the results, 3 kinds of dry fruits with the highest number of breeding acaroids mites from the samples were chosen. They are *Ligustrum lucidum Ait*, *Hazelnut*, and *Trichosanthes kirilowii Maxim*. They were cultivated and observed under artificial circumstances.We found that the *T. putrescentia*, *C. berlesei* and other species of acaroid mites breeding initially took up respectively 53%, 36% and 11%. However, after every 2W we found that the number of *T. putrescentia* raised from 12.47 per gram at 2W to 15.71 per gram at 4W. When it came to 8W, it gradually raised to 23.63 per gram, following by a decline to 19.54 per gram at 12 W; the number of *C. berlesei* experienced a decline from 8.54 per gram at 2 W to 5.71 per gram at 8W and to 0 at 12W.

Table I
Breeding Density of Acaroid Mites in Chinese fruit-derived medicinal materials

Sample	*Weight/g*	*Species of Breeding Acaroid Mites*
Ligustrum lucidum Ait	78.97	*T. putrescentia, C. berlesei, L. michaeli*
FRUCTUS LYCII	64.13	*T. putrescentia, G. ornatus, D. farina*
Castanea mollissima	54.48	*T. putrescentia, C. lactis, G. domesticus, A. ovatus*
Solanum mammosum L	44.63	*C. lactis, C. berlesei, E. maynei*
Actinidia chinensis	36.51	*T. putrescentia, C.lactis, G. domesticus*
Hazelnut	36.13	*T. putrescentia, S. nesbitti, C. berlesei*
Vitis vinifera	29.62	*G. domesticus, C.lactis, C. berlesei*
Juglans regia	22.17	*T. casei, C. berlesei*
Ficus carica Linn	20.93	*G. domesticus, G. ornatus, B. tropicalis*
Rosa laevigata Michx.	19.43	*C. lactis, G. ornatusKramer, M. fungivorus*
Rubus idaeu	19.38	*T. putrescentia, C. lactis, G. ornatus*
Trichosanthes kirilowii Maxim	18.68	*T. putrescentia, G. fuscus, C. berlesei*
Hippophae rhamnoides Linn	18.13	*T. putrescentia, C. lactis, E.maynei*
Litchi chinensis Sonn	16.27	*T. casei, C. lactis, C. berlesei*
Chaenomeles sinensis (Thouin) Koehne	12.67	*T. casei, C. berlesei*
Cornus officinalis Sieb. et Zucc	12.35	*G. domesticus, T. putrescentia*
Crataegus pinnatifida Bunge	11.25	*C. lactis, G. domesticus, A. siro*
Torreyagrandis 'Merrillii'	10.73	*G. domesticus, T. putrescentia*
Siraitia grosuenorii	10.32	*T. putrescentia, S. nesbitti*
Malus	10.08	*G. domesticus, C. lactis, G. ornatus*
Ziziphus zizyphus	9.76	*G. domesticus, G. ornatus, C.lactis*
Amygdalus Communis Vas	8.79	*G. domesticus, C. lactis, C. berlesei*
Ficus carica Linn	8.63	*T. putrescentia, T. longior*
Sapindus	8.56	*T. casei, C. lactis, T. putrescentia*
Eriobotrya japonica (Thunb.) Lindl	8.51	*C. lactis, C. berlesei, S. nesbitti*
Citrus medica L. var. sarcodactylis Swingle	8.49	*L. konol, T. putrescentia, E. maynei*
Fructus Mori	8.32	*T. putrescentia, G. domesticus, G. bicaudatus*
Chinese olive	5.68	*D. fainae, T. longior*
Malus hupehensis(Pamp.) Rehd	4.85	*T. longior, C.lactis, G. domesticus*
Elaeagnus angustifolia Linn	4.71	*C. berlesei, E.maynei*
fructus choerospondiatis	4.64	*C. lactis, G. domesticus, D. fainae*
Ziziphus jujuba Mill. var. spinosa (Bunge) Hu ex H. F. Chow	3.22	*C.lactis, A. siro*
Pomegranate Rind	2.85	*G. domesticus, C. lactis, T. putrescentiae*

Discussions

At present, house dust mites and stored product mites are wide in species, belonging to *Aearida*, *Oribatida*, *Aetinedida* and *Gamasida*. Mites belonging to *Aearida* surpass half of the total number[14-17], including 7 families, namely, *Acarida*e, *Lardogly phidae*, *Glycyphagidae*, *Chortoglyphidae*, *Carpoglyphidae*, *Histiostomidae*, and *Pyroglyphidae*[18]. Acaroid mite is a tiny arthropod widely distributed around the world, most of which live on themselves, feeding on organic ort of animals or plants. Their ideal habitat includes grains, Chinese medicinal materials, dry fruits and vegetables in storages, as well as textile fabric and dust in human dwellings[18,19]. Acaroid mites are selective about humiture and food in their breeding places[20].

Table II
Species of Acaroid Mites in Chinese fruit-derived medicinal materials

Genus	*Family*	*Species*
Acaridae	*Acarus*	*A.siro*
	Tyrophagus	*T. putrescentiae*
		T. longior
		T. palmarum
	Mycetoglyphus	*M. fungivorus*
	Aleuroglyphus	*A. ovatus*
	Suidasia	*S. nesbitti*
	Cologlyplus	*C. berlesei*
	Tyrolichus	*T.casei*
Lardoglyphidae	*Lardoglyphus*	*L. konoi*
Glycyphagidae	*Glycyphagus*	*G. ornatus*
		G. domesticus
		G. bicaudatus
	Blomia	*B. tropicalis*
	Lepidoglyphus	*L. michaeli*
	Gohieria	*G. fuscus*
Carpoglyphidae	*Carpoglyphus*	*C. lactis*
Pyroglyphidae	*Dermatophagoides*	*D. farinae*
		D. pteronyssinus
	Euroglyphus	*E. maynei*

Situated at the eastern part of China and at the middle and lower reaches of Yangtze River, with a wide span from south to north, Anhui province enjoys a subtropical humid monsoon climate. It also enjoys ample rainfall and four distinctive seasons. Its annual average temperature ranges from 15ºC to16ºC.In summer and autumn, the average temperature reaches 29~33ºC,and the humidity is around 68%~76%, wich is very conductive to breed a large amount of acaroid mites. LI Chao-pin and other people[21] surveyed the composition and diversity of stored acaroid mites in Anhui province and found that the average breeding density, species richness and diversity in southern Anhui regions (including Wuhu area) are higher than that in Huaibei Plain, Jianghuai Hily Region, and plain in central Anhui.

In order to discuss acaroid mites in dry fruits and the growth and decline of acaroid mites community in different months, such indexes as average breeding density, diversity index, richness index and evenness index of acaroid mite community from the same storage respectively in January, April, July and October were compared and analyzed in this study. It turned out that the highest richness index and diversity index were in July, while the highest average breeding density was found in October, and the highest evenness index in April. The distribution of acaroid mites is influenced by humiture, illumination, their own eating habits, human interference factors and other factors[22-24]. We explain the results mentioned above from the fact that, the average relative humidity and temperature of the storage sampled in July were respectively 75.6% and 31ºC. Closed in a long time, unventilated and with a poor air flow and unscheduled cleaning; the storage had acaroid mites breeding in large amount. However, when samples were collected in October, the temperature and humidity there were respectively 25ºC and 66%. Because acaroid mites have a relatively long breeding season, many female acaroid mites spawn in summer and breed in large number in autumn. Therefore, despite a little decline in richness and diversity, breeding density reaches the peak in October. Apart from that, with a low temperature, spring is not suitable for acaroid mites to breed, while for those having a relative low requirement for humiture, such as *T. putrescentiae*, they can easily live and breed. As a result, the evenness of them is the highest in April. From all mentioned above, excluding human factors and food influences, the average breeding density, diversity index, and richness index of the community as well as evenness index are closely related with humiture. In summer and autumn, when the humiture is high, the indexes mentioned before are high; if the humiture is not suitable for acaroid mites to live, they would choose to exist in resting body[25].

Ligustrum lucidum Ait, *Hazelnut*, and *Trichosanthes kirilowii Maxim* enjoy a relatively high average breeding density of acaroid mites, mainly *T. putrescentiae* and *C. berlesei*. To understand parameter change rules of the two acaroid mites'living habits and environment, we cultivated *Ligustrum lucidum Ait*, *Hazelnut*, and *Trichosanthes kirilowii Maxim* in the laboratory.

As the result shows, the number of *C. berlesei* continued to decrease, while *T. putrescentiae* continued to breed and their number reached the peak at 8W, the number of species saturated; after that, as other species of mites appeared and the food is relatively insufficient, which caused a slight decline in *T. putrescentiae*'s number at 10W and 12W. These change rules are relevant with acaroid mites'habits and interspecies predominance. Within the same community, there's usually one predominant species of mites, which has a distinctive controlling function on the formation of community structure and environment. They usually enjoy a large number, a high biomass, and a relatively high living ability. Therefore, they breed in large quantity in this stored material while restraining other species of mites from breeding[16,26,27]. However, after acaroid mites breed to a certain extent, their natural enemy, *Cheyletus eruditus*, start to appear and breed in large quantity, in a dynamic equilibrium[20,28].

From all mentioned above, we believe that acaroid mites breed extensively in stored dry fruits of Anhui province. We detected *G. domesticus* and *T. putres-*

Table III
Ecological Parameters of Acaroid Mites in Different Chinese fruit-derived medicinal materials

Ecological Parameters	*Chinese fruit-derived medicinal materials*				
	Ligustrum lucidum Ait	*FRUCTUS LYCII*	*Castanea mollissima*	*Solanum mammosum L*	*Actinidia chinensis*
Breeding Density	78.97	64.13	54.48	44.63	36.51
Richness Index	1.33	1.54	2.01	0.87	1.64
Diversity Index	1.38	1.70	2.70	1.71	1.99
Evenness Index	0.92	0.90	0.94	0.94	0.92

Table IV
Seasonal Parameter Changes of Acaroid Mites Community in Chinese fruit-derived medicinal materials

Month	*Average Breeding Density (No./g)*	*Richness Index*	*Diversity Index*	*Evenness Index*
January ~	6.73 ± 3.25	2.145 ± 0.037	1.351 ± 0.210	0.927 ± 0.041
April ~	5.69 ± 3.00	1.531 ± 0.115	1.073 ± 0.110	0.955 ± 0.034
July ~	10.35 ± 2.53	6.131 ± 0.021	3.259 ± 0.082	0.811 ± 0.053
October ~	11.68 ± 2.21	5.509 ± 0.011	2.939 ± 0.075	0.841 ± 0.022

centiae in *Ligustrum lucidum Ait*, *FRUCTUS LYCII*, *Castanea mollissima* and many other dry fruits. The richness index, diversity index and breeding density of acaroid mites in July are the highest in the year, which have much to do with humiture. We observed the growth and decline of *C. berlesei* and *T. putrescentiae* under artificial circumstances, and found a sharp decline in the number of *C. berlesei* and firstly an increase and then a decline in the number of *T. putrescentiae*. We think that acaroid mites and variations in their species reflect changes in the local environment and climate, but the idea needs further study.

During separation process, we only identified part of mite species in the samples, leaving other species apart from acaroid mites uncounted. As far as acaroid mites are concerned, they can't be totally separated out. Therefore, species of acaroid mites in the samples are actually more than that recorded here. The breeding density of sampled mites is represented through the number of mites in the overall samples, which is indirectly calculated through that in proportional samples. Therefore, it can only give a general reflection of breeding density in various samples. The study shows that, when the breeding density of acaroid mites in stored dry fruits increases to a certain amount, acaroid mites would move and spread around. While moving, they would spread many species of microorganism like bacterium and fungus. Therefore, rubber powder in storages should be appropriately deposited to prevent transmission by acaroid mites.

Information about the species, density, and diversity of Chinese fruit-derived medicinal materials in different parts of Anhui province was initially surveyed, in an effort to provide theoretical references for proper acaroid mites prevention scheme.

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Conflict of Interest

None declared

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