

Experimental Evaluation of Three Tarantula Species for Commercial Captive Breeding

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Abstract. With the increasing attention given to tarantulas in the pet trade and related biological material research, establishing a stable captive breeding system while reducing the pressure of wild collection has become a worthy research question. This study compared the performance of the orange tarantula (*Pterinochilus murinus*), the pumpkin tarantula (*Hapalopus formosus*), and the tiger tarantula (*Selenocosmia huwena*) in terms of growth, molting, survival, silk production, and feed utilization through a six-week controlled rearing experiment. The results showed that the orange tarantula exhibited the best adaptability, as all 10 individuals completed molting, the average leg span increased from 3.41 ± 0.09 cm to 4.05 ± 0.10 cm, and the mortality rate was 0. The pumpkin tarantula had a molting success rate of 40%, slower growth, but the lowest stress response. Only 20% of the tiger tarantula individuals completed the molting process, while the mortality rate soared to 60%. The finding clearly indicates that wild-caught individuals are not suitable as a stable breeding base. Regarding feed, mealworms and crickets showed no significant difference in short-term growth increment, but mealworms had a higher acceptance rate and lower waste, making them more suitable for daily management. Overall, among the three species, the orange tarantula holds the greatest commercial potential for artificial breeding, and the establishment of a sustainable tarantula industry should rely on captive - bred populations.

Keywords: Tarantula farming, artificial breeding, feed efficiency, molting, species suitability

1. Introduction

In recent years, the tarantula trade has been continuously expanding. Studies show that a significant number of tarantula species have entered the online market, and some newly described species are even traded before basic ecological data is fully collected [1]. Raymundo et al. documented at least 14,662 tarantulas in the Philippine social media trading groups, involving at least 135 species, with the vast majority being non-native species. CITES assessments also reveal that some tarantula genera have a large number of wild-source individuals in international trade [2]. This indicates that the tarantula trade is not merely a problem of a niche pet market, but also related to wild collection pressure, animal welfare, and the maturity of artificial breeding systems [3]. From the commercial breeding perspective, tarantulas have the characteristics of small footprint, low feed requirements, high reproductive capacity of some species, and the ability to produce silk. However, currently, there is a lack of breeding programs verified through experiments [4, 5]. This study selected orange

baboon tarantula, pumpkin tarantula, and tiger tarantula as subjects to compare their growth performance, molting frequency, survival rate, silk production, and stress response [6]. Two common feeds, mealworms and crickets, were employed to determine the suitability of different species and feeds for commercial tarantula farming.

2. Materials and methods

2.1. Experimental design

This study conducted a six-week controlled experiment. The experimental subjects consisted of 10 juveniles from each of the following species: Orange Baboon Tarantula, Pumpkin Tarantula, and Tiger Tarantula, amounting to a total of 30 individuals. The Orange Baboon Tarantula and Pumpkin Tarantula were captive-bred individuals, whereas the Tiger Tarantula was a wild-caught individual because of the absence of a stable source for captive breeding. All individuals were allowed 7 days of acclimatization upon arrival before the formal recording commenced to minimize the short-term stress caused by transportation and environmental changes.

2.2. Rearing management and feeding program

Each tarantula was individually housed in a 5×5×5 cm transparent plastic box to prevent cannibalism and facilitate tracking. The Orange Baboon Tarantula was kept in a 1 cm thick layer of dry red clay substrate with a humidity of approximately 40%. The Pumpkin Tarantula and Tiger Tarantula were housed in a 2 cm thick layer of moist coconut fiber substrate with a humidity of approximately 80%. All rearing boxes were placed in a constant temperature environment of 28.5±1.5°C, with minimal exposure to strong light and unnecessary disturbance.

Ten individuals of each tarantula species were divided into two feeding groups: individuals numbered 1-5 were fed mealworm larvae (*Tenebrio molitor*), and individuals numbered 6-10 were fed house crickets (*Acheta domesticus*) [7-11]. Feeding was conducted twice a week, on Mondays and Thursdays. Unprepared prey was removed after 24 hours, and individuals that refused to eat were suspended from feeding until they resumed normal activity or feeding.

2.3. Growth and molting data recording

This study primarily evaluated growth based on molting events and changes in leg span. Throughout the experiment, the rearing boxes were inspected daily, and data on molting dates, feeding refusal, burrow closure, silk usage, and mortality were recorded. Leg span was defined as the distance from the tip of the first step to the posterior end of the opposite fourth step, and it was measured approximately five days after molting to minimize errors resulting from the unhardened exoskeleton.

During measurements, a fixed-height camera was used to photograph the rear of the individuals from above the rearing box, with a metric ruler placed in the image for scale reference. Digital measurements were then performed using Image J. The time of death of deceased individuals was recorded, and external observation was conducted to check for trauma, parasites, fungal infections, or significant dehydration [12].

2.4. Feed utilization and silk production assessment

To assess feed utilization efficiency, this study recorded whether prey was preyed upon within 24 hours after each feeding, and calculated the prey acceptance rate using the following formula:

$$\text{Prey Acceptance Rate (\%)} = \frac{\text{Number of Prey Preyed}}{\text{Number of Prey Provided}} \times 100\% \quad (1)$$

When cleaning the rearing boxes, uneaten residue was visually sorted and weighed, and the feed waste rate was calculated using the following formula:

$$\text{Feed Waste Rate (\%)} = \frac{\text{Mass of Remaining Prey Residue}}{\text{Total Mass of Prey Fed}} \times 100\% \quad (2)$$

Since this study did not directly measure weight changes, a strict feed conversion ratio was not calculated. Instead, the prey acceptance rate and feed waste rate were used to compare the actual management efficiency of the two feeds.

At the end of the experiment, silk production was semi - quantitatively scored on a scale of 1 to 5: a score of 1 indicated a small amount of silk or a simple molting pad, a score of 3 indicated a medium - sized web or concealed structure, and a score of 5 indicated extensive, complex, and dense silk coverage. All scores were completed by the same observer to reduce subjective variability.

2.5. Molting behavior and stress level assessment

Pre-molting behavior included food refusal, reduced activity, closing of burrow entrances, and changes in silk usage. The molting interval was defined as the number of days between two successful molts; for individuals that completed only one molt, the duration from the start of the experiment to their single molting event was recorded.

Stress level was quantified via an immediate behavioral response score, which was assessed by lightly tapping the breeding box lid twice weekly: a score of 1 represented no obvious response, 3 represented retreat or evident fright, and 5 represented immediate escape or defensive posture [13].

2.6. Data processing and statistical analysis

After the experiment, molting data, leg span changes, prey acceptance rate, feed waste rate, silk production scores, and stress scores for each individual were collected, and the mean and standard deviation for each species and feed group were calculated.

Since all 10 orange baboon tarantula individuals completed successful molting, the corresponding dataset was fully intact. Therefore, an independent samples t-test was used to compare the difference in leg span growth between the mealworm group and the cricket group, with a significance level set at $\alpha=0.05$. For the pumpkin-spotted tarantula and tiger-striped tarantula, fewer individuals successfully molted, so descriptive statistics and qualitative comparisons were mainly used.

3. Results

3.1. Overall growth pattern and molting frequency

During the six-week experiment, different species exhibited significant differences in growth and molting (Figure 1). All 10 individuals of the orange baboon tarantula completed molting, a success rate of 100%; 4 individuals of the pumpkin-spotted tarantula completed molting, a success rate of 40%; while only 2 tiger tarantula individuals successfully molted, yielding a 20% molting success

rate, with 6 individuals dying during the experimental period. Overall, the orange baboon tarantula had the shortest growth cycle and the best adaptability. Although tiger tarantulas exhibited greater single-molt growth amplitude, they showed significantly higher mortality rates and stress responses.

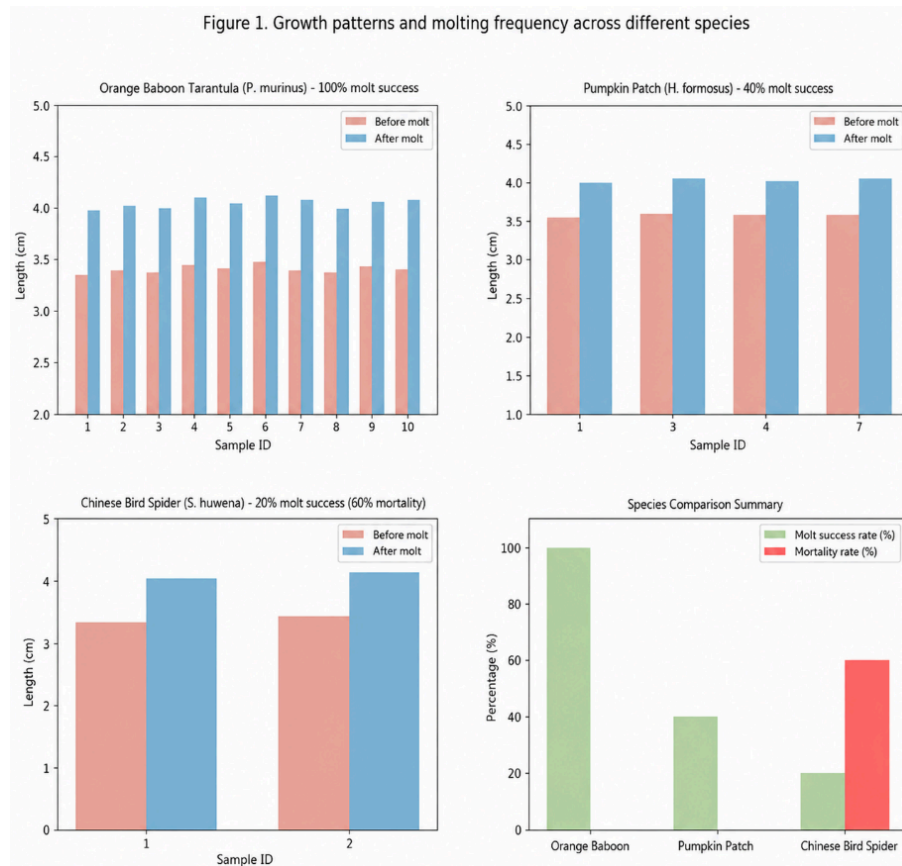


Figure 1. Growth patterns and molting frequency across different species

3.2. Species-specific growth performance

The average foreleg span of the orange baboon tarantula after molting was 3.41 ± 0.09 cm, increasing to 4.05 ± 0.10 cm after molting (Figure 2), an average increase of 0.64 cm, equivalent to an 18.8% increase in body size. Comparing the feed groups, the average growth rate was 0.60 cm in the mealworm group and 0.56 cm in the cricket group, with no statistically significant difference ($t=1.00$, $p=0.35$).

The average leg span of successfully molted individuals of the pumpkin-spotted tarantula increased from 3.58 ± 0.08 cm to 4.03 ± 0.05 cm (Figure 2), an average increase of 0.45 cm, equivalent to a 12.6% increase in body size. The average growth rate of the cricket group was 0.50 cm, slightly higher than the 0.43 cm in the mealworm group, however, due to the limited sample size of successfully molted individuals, this result only serves as a preliminary trend reference.

Only 2 individuals of the tiger tarantula successfully molted, with the average leg span increasing from 3.40 cm to 4.10 cm, representing an average growth of 0.70 cm (20.6%). This single growth rate was higher than the other two tarantula species, but the 60% mortality rate made its overall aquaculture performance unstable. No obvious signs of external injury, parasitism, or dehydration were observed in the deceased individuals, suggesting that wild capture and environmental adaptation may be significant sources of risk.

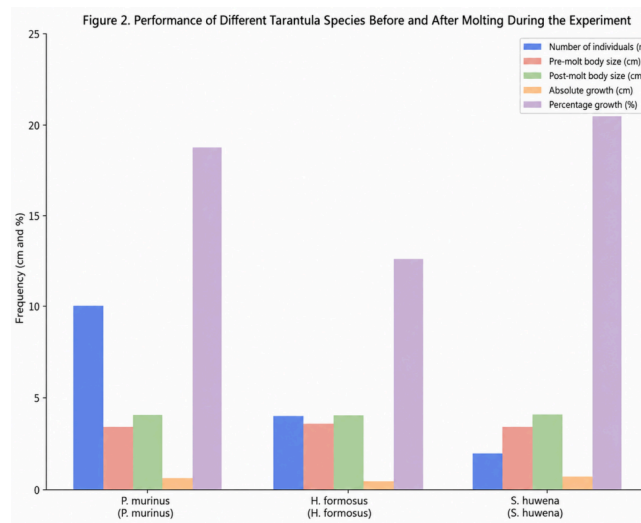


Figure 2. Performance of different tarantula species before and after molting during the experiment

3.3. Feed conversion rate and prey preference

Feeding efficiency showed that mealworms were more suitable for routine management (Figure 3). The prey acceptance rate in the mealworm group was $95.2\% \pm 3.1\%$, higher than that in the cricket group ($80.4\% \pm 7.8\%$) ($p < 0.01$); the feed waste rate, estimated by weight, was $4.5\% \pm 2.1\%$, significantly lower than that in the cricket group ($14.7\% \pm 4.2\%$). This may be related to the lower activity level of mealworms and the greater amount of edible parts, while crickets' wings and hind legs are more often discarded.

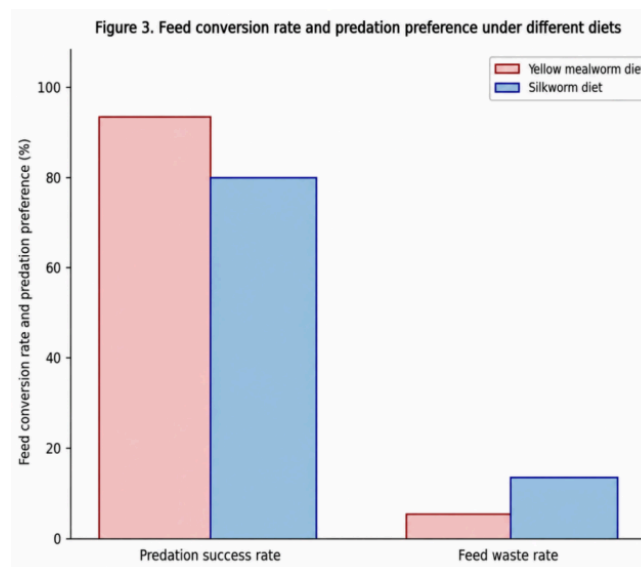


Figure 3. Feed conversion rate and predation preference under different diets

3.4. Intermolting period and behavioral analysis

Intermolting periods showed significant differences among species (Figure 4). The shortest molting interval was 28.5 ± 2.1 days for the orange tarantula, 35.0 ± 3.5 days for the pumpkin tarantula, and the longest was 48.5 ± 1.5 days for the tiger tarantula, accompanied by approximately 12.0 ± 2.0

days of pre-molting fasting and burrowing behavior. The shorter molting interval means a faster production cycle, thus giving the orange tarantula a greater advantage in commercial breeding.

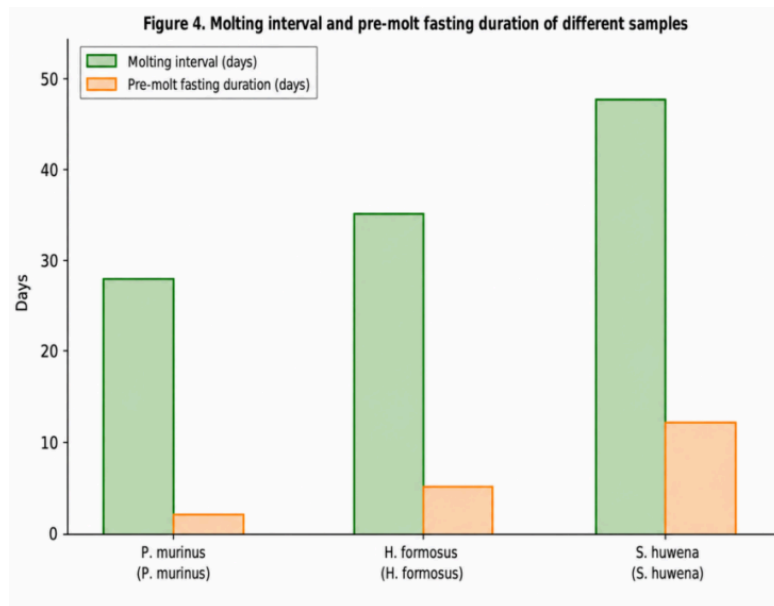


Figure 4. Molting interval and pre-molt fasting duration of different samples

3.5. Silk yield assessment

The silk yield score showed that the orange tarantula had the highest, averaging 4.5 ± 0.5 , often forming extensive structured webs; the tiger tarantula had a score of 3.5 ± 0.7 , mainly forming thicker layered molting pads; the pumpkin tarantula had the lowest, at 2.0 ± 0.8 , with silk mostly used for simple molting pads (Figure 5).

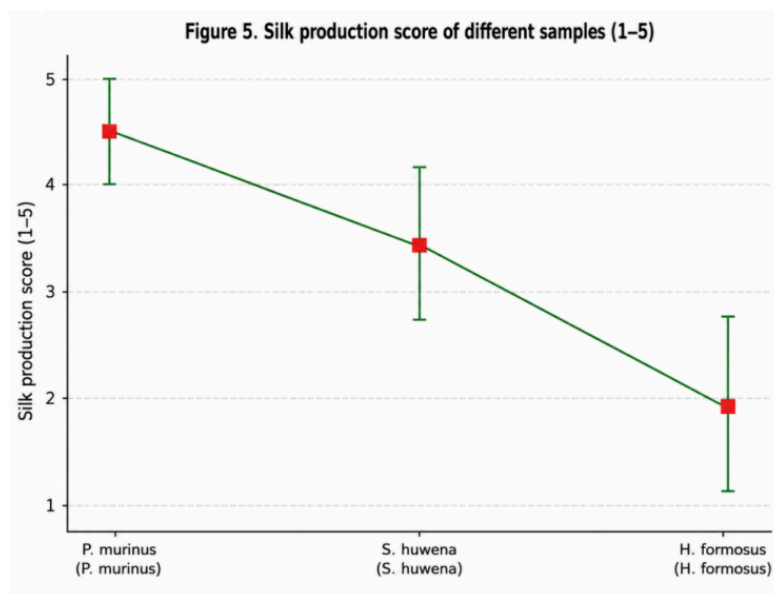


Figure 5. Silk production score of different samples(1-5)

3.6. Physiological stress indicators

Stress scores showed the opposite trend (Figure 6). The highest mortality rate was observed in wild-caught tiger tarantulas (4.2 ± 0.8), while that of captive-bred orange baboon tarantulas was 2.1 ± 0.6 , and that of pumpkin tarantulas was the lowest (1.8 ± 0.7) ($F = 45.2$, $p < 0.001$). This indicates that tiger tarantulas have a high difficulty adapting to captive environments, which may explain their high mortality rate.



Figure 6. Stress response score of different samples under experimental conditions

4. Discussion

This study demonstrates that for captive tarantula rearing, species-specific biological and behavioral traits exert a stronger influence on rearing outcomes than feed type. Mealworms and crickets can both support individual growth, but different species show greater differences in molting rate, mortality rate, stress response, and silk production. Therefore, the primary issue for commercial farming is not simply choosing a more nutritious feed, but rather selecting species suitable for artificial environments that can reproduce and be managed stably.

The orange baboon tarantula is the most suitable candidate species for commercialization in this experiment. It achieved a 100% molting success rate, 0 mortality rate, shortest molting interval, and highest silk production score within six weeks, indicating its good adaptability to artificial rearing conditions. For the pet trade, rapid and stable molting is beneficial for predicting sales sizes and growth cycles; for silk or biological materials, high web production also provides further research value.

The findings for tiger tarantulas highlight that wild-harvested individuals cannot support sustainable commercial rearing operations. The species exhibited the highest single-molt size growth, but a 60% mortality rate and the highest stress score indicate that its adaptation costs are too high. The deceased individuals showed no obvious external injuries, suggesting the problem may not be caused by a single rearing operation, but rather by capture, transportation, environmental changes, or underlying health issues. Therefore, the tiger tarantula is not suitable for commercial breeding until a stable captive breeding population is established.

The pumpkin tarantula may not be suitable for large-scale biomass or silk production, but it still has some value in the pet market. Its small size, minimal space requirements, and lowest stress score

suggest it is more suitable as a specialty pet species. Although its molting success rate and growth rate are lower than those of the orange baboon tarantula, its low aggression and ease of management can lower the barrier to entry for novice breeders.

Feed results indicate that the advantage of mealworms lies primarily in management efficiency, rather than short-term growth promotion. Both crickets and mealworms can meet the basic growth needs of tarantulas [8, 10, 11], therefore there was no significant difference in leg span growth between the two groups of orange baboon tarantulas. However, mealworms have a higher acceptance rate, lower waste, and lower activity, thus causing less disturbance to the tarantula's molting process, making them more suitable as a basic daily diet. Crickets can still be used as supplementary feed to increase dietary diversity.

This study also has limitations. First, each species was represented by only 10 experimental individuals, and the number of successfully molted pumpkin-spotted and tiger tarantulas was further reduced; accordingly, certain statistical outputs merely provide preliminary trend indications. Second, the experiment lasted six weeks, covering only the short-term growth of the larval stage and cannot directly represent the complete life cycle or reproductive efficiency. Third, the tiger tarantula was from a wild-caught source, while the other two species were from captive breeding, making it difficult to completely separate species differences from source differences.

Future research could expand the sample size, extend the experimental time, and incorporate indicators such as body weight, dry weight of food, reproductive success rate, and spider silk mechanical properties [14]. In particular, for the orange tarantula, further testing under different temperatures, humidity levels, feed ratios, and breeding conditions is needed to establish a more comprehensive captive breeding program. For wild-sourced species such as the tiger tarantula, priority should be given to developing stable captive breeding populations rather than directly expanding wild collection.

Overall, the key to commercial tarantula farming is not simply pursuing large or rare species, but rather selecting species that can stably adapt to artificial environments. The orange baboon tarantula is suitable for large-scale farming and silk-related research, the pumpkin tarantula is suitable for the specialty pet market, and the tiger tarantula is better suited as a counterexample to the risks of wild capture.

5. Conclusion

This study shows that the core of commercial tarantula farming is selecting species suitable for artificial environments. The orange baboon tarantula performs best in terms of growth rate, molting success rate, survival rate, and silk production, making it the most promising candidate for artificial breeding among the three species. The pumpkin tarantula grows slower, but its small size and stable temperament make it more suitable for the pet market. Although tiger tarantulas exhibit substantial single-molt growth potential, their elevated mortality and stress response levels suggest wild-sourced specimens are unsuitable for immediate large-scale commercial cultivation. Regarding feed, mealworms did not significantly increase short-term growth, but their high acceptance rate and low waste make them more suitable as a basic feed. Overall, sustainable tarantula farming should be based on artificially bred populations, stable rearing conditions, and long-term data.

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