

The Use of Silver Vine (*Actinidia Polygama* Maxim, Family Actinidiaceae) as an Enrichment Aid for Felines: Issues and Prospects

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Abstract: Problem statement: This study highlights the potential of using silver vine as an enrichment additive for felines. **Approach:** A literature review was conducted on the use of silver vine since 1973. The articles were categorized into studies concerned with behavior, biological effects, beneficial uses, plant and chemical studies. **Results:** We found surprisingly few studies that utilized silver vine. There were only four studies concerned with the effect of silver vine on behavior and no behavior studies have been conducted since 1997. Only one study was found in the biological domain that explored the effects of silver vine on amygdala (which was thought to affect sexual behavior) by surgically removing the amygdala. No studies in the biological domain were found after 1979. In contrast to studies of biology and behavior, the literature contained sixteen articles on various aspects of plants with none published since 2008. Articles included studies on root pressure and shoot development, freezing temperatures and the cold-hardiness of the plant. Others explored the fruit of the plant and relationship with matatabi fruit gall midge, *Pseudasphondylia matatabi* that infected them. Eighteen articles on the beneficial uses of silver vine were found with none published since 2009 and twenty-two articles concerned with the chemistry of silver vine were found with two published since 2008. These articles concerned the organic chemistry of compounds found in the plant, as well as the chemistry that occurred when *P. matatabi* infected the fruit, which produced new chemical compounds in the plant. In conducting the literature review, we uncovered an error in the literature where silver vine was considered addictive to cats. We subsequently showed that no scientific data exists demonstrating any purported addictive properties of silver vine. The original conclusion that silver vine had addictive properties was based solely upon a single uncontrolled anecdote that, unfortunately, had been perpetuated in the literature to the present day. **Conclusion:** Behavioral research on silver vine as an aid to enrichment devices for felines is an unexplored area. Silver vine has much potential for use with enrichment devices and is very easy to use.

Key words: Silvervine, matatabi, cat, leyhausen

INTRODUCTION

Enrichment devices are designed to enhance the quality of animal-human interactions and have become an active area of research (Shepherdson, 1998; Ellis, 2009; Tarou and Bashaw, 2007; Shyne, 2006). Devices for home use and those used in zoos and animal parks attempt to stimulate an animal's senses and cognitive abilities by manipulating objects in their environment. In addition to enhancing animal-human interactions, enrichment devices can be used by veterinarians to

improve the physiological well-being of sick animals such as those suffering from arthritis and obesity.

Enrichment also improves the psychological well-being of animals. One meta-analysis of 63 studies on effects of enrichment of mammals at zoos, 13 of which were on felines, found that enrichment decreased abnormal and stereotypical behaviors in 90% of the studies (Shyne, 2006). Many reports of feline enrichment focus on the use of food as enrichment. Some studies reported an increase in desirable activity, such as hunting in African lions (Powell, 1995), African

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leopards (Markowitz *et al.*, 1995) and fishing cats (Shepherdson *et al.*, 1993). Other studies reported both an increase in desirable activity and a reduction in stereotypical behaviors using food enrichment such as live fish and horse leg bones in African lions and Sumatran tigers (Bashaw *et al.*, 2003). Inedible enrichment, such as spices, has also been shown to increase desirable activity and decrease stereotypies in several feline species (Skibel *et al.*, 2007). Other objects not associated with food, such as Boomer Balls® and other plastic toys may also induce desirable activity such as hunting behaviors (Mellen and Shepherdson, 1997).

In addition to decreasing undesirable behaviors, enrichment may also contribute to visitor interest through an increase in activity. Across institutions and species, visitors perceive active animals to be more interesting than inactive animals (Bitgood *et al.*, 1988). Margulis *et al.* (2003) reported that an increase in activity of six feline species produced an increase in visitor interest and number. They suggest that providing enrichment for felines may increase activity and in turn increase visitor interest.

One of the keys to a successful device is maintaining the animal's interest in the enrichment item. This can be accomplished, for example, by finding a stimulus that can be used to stimulate the senses and be rewarding to the animal. Mellen and Shepherdson (1997) suggest that no single type of enrichment is always effective and that managers must always search for new options for enrichment. The use of silver vine as feline enrichment provides a previously unexplored option.

The purpose of this study is to suggest that silver vine (*Actinidia polygama* Maxim, Family Actinidiaceae) be evaluated as an enrichment aid. Silver vine is a deciduous shrub indigenous to Japan and Korea and is commonly used in Asian medicine. Anecdotal evidence suggests that it is highly attractive to cats as evidenced by salivation and increased activity (Shoyama *et al.*, 1998). A silver vine branch is usually given to a cat to stimulate a response (Katahira and Tsukahara, 1974) of salivation, licking, playful rubbing, rolling, treading with hind legs and finally sleeping (Hayashi, 1968). We reviewed the literature on silver vine and suggest avenues for future behavioral research. Of special interest is that we have uncovered an error in the literature that suggested silver vine is addictive to cats. This error has become part of the behavioral literature on silver vine and is based only upon a single anecdotal observation under poorly controlled conditions.

The error mentioned above appeared in the Bayer-Symposium IV, Psychic Dependence in an article entitled "Addictive Behavior in Free Ranging Animals" by Paul Leyhausen (1973). Leyhausen published numerous scientific papers and books. His research helped to design feline enclosures in many zoos. However, in this particular publication, he recites some of his observations of the effects of silver vine on the large cats of Osaka Zoo. From his observations, he concluded that the cats became addicted to silver vine because "the cats became so eager that the moment they saw the experimenter appear they left everything, including food, sexual intercourse or whatever it was and just ran up to the bars and waited for this smell [of silver vine]" (Leyhausen, 1973). However, there is a flaw in Leyhausen's reasoning, which is admitted by Leyhausen himself. He states that silver vine: (Leyhausen, 1973):

Affected [the cats'] sense of smell and in the end damaged their brains, as my Japanese counterparts told me... the zoo director was not very keen on having sufficient experiments and autopsies made to confirm the results on brain damage statically, because he likes to have animals healthy and alive in their cages. For that reason, this part of the story is anecdotal. There is no experimental statistics proving that the brain is affected.

Unfortunately, this observation has been recited in more recent scientific articles and is written as a scientific truth, such as in Tucker and Tucker (1988) well-known article entitled "Catnip and the Catnip Response". The authors state, "an extract of [silver vine] apparently induces addictive behavior and continual stimulation may produce brain damage in cats," and cite Leyhausen's publication in *Psychic Dependence*. Because this article is so well known in the study of plants that effect feline behavior, it is cited in an additional 14 scientific articles that may further spread the error (Bernier *et al.*, 2005; Blum *et al.*, 1990; Chizzola, 2006; Frank *et al.*, 2010; Herron, 2001; Ibrahim and El-Moaty 2010; Kelly 1996; Lee *et al.*, 2010; McCaskill, 1997; Weldon 2004; Skaltsa *et al.*, 2000; Zhao *et al.*, 2006; 2007).

MATERIALS AND METHODS

A content analysis was conducted from June 2010 through August 2010. Scientific articles written in or after 1973 (N = 57) containing information on the silver vine plant were coded. The defining year of 1973 was based on the year that the first known published error of

silver vine being addictive to cats appeared. Three different search engines were used to search for scientific articles; (1) Oklahoma State University's Library database, (2) Google Scholar and (3) Web of Science. A keyword search was conducted using each search engine. Keywords were: "*Actinidia polygama*," "silvervine" and "silver vine."

The articles were classified into the following areas based on content: behavior-articles relating to behavioral effects of exposure to silver vine, biology-articles relating to the effects of exposure on a biological system, beneficial uses-articles relating to any practical use for humans or animals, plant-articles relating to the physiology and ecology of silver vine and chemical-articles relating to chemistry of compounds found in the plant. Articles that contained the error made by Leyhausen (1973), or the errors further spread by Tucker and Tucker (1988) were noted but not further classified.

RESULTS

Table 1 summarizes the findings of our literature review (Hayashi, 1968; Baranec and Murin, 2003; Barrero *et al.*, 2005; Sulaiman and Yukawa, 1992; Boldingh *et al.*, 2000; Chat, 1995; Clapperton *et al.*, 1994; Clearwater, 2004; 2006; 2007; Derambure and Hirsch, 1995; Enders and Kaiser, 1997; Hiramatsu *et al.*, 2004; Hirsch, 1979; Hirsch *et al.*, 2001; Hooper *et al.*, 2002; Jung *et al.*, 2003; Katahira and Tsukahara, 1974; Katahira and Iwai, 1975; Katahira *et al.*, 1975; Katahira and Tsukahara, 1978; Katsube *et al.*, 2004; Kawagoe and Suzuki 2004; Kigawa *et al.*, 1992; Kim *et al.*, 2006; Kim *et al.*, 2003; Lai, 2007; Lawes *et al.*, 1995; Lee *et al.*, 2006; Matich *et al.*, 2010; Matsuzawa *et al.*, 1989; 1986; McGhie and Ainge 2002; Otsuka *et al.*, 2003; Patocka and Jakl 2010; Ren *et al.*, 2007; Sakai *et al.*, 1980; Santangelo *et al.*, 2001; Sashida *et al.*, 1992; 1994; Sugawara *et al.*, 1994; Takazawa *et al.*, 2002; Tanaka *et al.*, 1997; Webby *et al.*, 1994; Wuest *et al.*, 1977; Xiao and Hirsch 1996; Xiufen *et al.*, 2004; Yoshizawa *et al.*, 1994; 2000a; 2000b 2002; Zhao *et al.*, 2006, 2007). In the review, we found no articles that support Leyhausen's (1973) suggestion that silver vine is addictive to cats. We also noted that little research regarding the behavioral and biological effects of exposure to silver vine has been conducted. Only four articles were found addressing the effects of silver vine on behavior and only one article was found addressing the biological effects. The majority (93%) of the articles found related to the biology or ecology of the silver vine plant, its chemical composition, or its practical uses.

Table 1: Number of articles found per year in each category

Year	Behavior	Biology	Beneficial Uses	Plant	Chemical
1973-1978	3	1	00	00	01
1979-1984	0	0	00	01	03
1985-1990	0	0	02	00	00
1991-1996	0	0	03	07	04
1997-2002	0	0	03	02	07
2003-2008	0	0	07	06	04
2009-2010	0	0	01	00	02
Total	3	1	16	16	21

DISCUSSION

The results of the literature review suggest that there is much potential for further investigation of silver vine in behavioral research and application. One area that silver vine may be particularly useful is in the enrichment of captive animals.

Silver vine may be used as enrichment in a variety of manners. Small amounts of silver vine may be presented in randomly altering locations throughout the exhibit to encourage an increase in general activity, similar to the use of spices described by Skibel *et al.* (2007). Silver vine may also be placed in areas that provide the public with a clear view of the animals to increase visitor interest.

Silver vine may be used to encourage felines to interact with other enrichment objects. Mellen and Shepherdson (1997) suggest that hiding food items in enrichment items such as Boomer Balls® may encourage exploration. Applying silver vine to these types of enrichment items provides an alternative to encouraging interaction with food and may have the benefits of not interfering with diet restrictions, being less likely to attract native species such as ants or rodents and a decreased likelihood of the animal ingesting part of the enrichment while attempting to get the food. Repeated associations with silver vine and specific enrichment items may produce a transfer of some of the effects through classical conditioning.

In addition to enrichment, silver vine may also be a potent reinforcer for husbandry behaviors in felines. Husbandry behaviors include training animals to eagerly cooperate with medical procedures such as tactile examinations and blood draws and routine behaviors such as moving between exhibits and holding space. Traditionally, husbandry behaviors are reinforced with food. In some cases food may not be an appropriate reinforcer, such as when the animal is on a restricted diet or uninterested in food due to illness or satiation. In these cases silver vine may be a very useful reinforcer.

Before silver vine can be efficiently employed as enrichment or as a reinforcer for felines, a basic understanding of the effects of silver vine is required.

One area of future study is the reliability of the effect of silver vine. Repeated presentations of silver vine may lead to a decrease in response, or a complete lack of responding, through a process known as habituation. Thompson and Spencer (1966) describe several properties of habituation that may be relevant to the use of silver vine. Weaker stimuli generally produce faster habituation, while responses to very strong stimuli may never habituate. Habituation also occurs more rapidly when less time elapses between stimulus presentations. If a response to a stimulus does become habituated, the response may spontaneously recover if the stimulus is not presented for some time. However, additional stimulus presentations after the response habituations may result in slower recovery. Finally, repeated series of habituation and spontaneous recovery may result in increasingly rapid habituation.

Previous research on habituation suggests that different amounts or concentrations of silver vine provided at different intervals may lead to different effects. A better understanding is needed to ensure that enrichment and training protocols do not unintentionally lead to a habituation of the effect of silver vine. An understanding of habituation of silver vine may also provide insight on methods to potentiate the use of silver vine as a reinforcer.

Additionally, much research on habituation has been conducted with reflexive behaviors. As silver vine produces a more diverse response than a single reflex, further research is needed to determine how the habituation of the response to silver vine compares to habituation to traditional stimuli.

CONCLUSION

In conclusion, the results of our review suggest that the potential for silver vine research and application may have been overlooked in recent years due to an unsupported but widely spread statement in the literature. We hope that the demonstration of this error and the suggested topics of research and application provoke interest in further investigation of the behavioral effects of silver vine.

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