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Research Article

Effect of Different Natural and Chemical Ingredients as Repellents of Pigs

Shad Mahfuz[1,2†], Hong-Seok Mun[1,3†], Veasna Chem[1], Keiven Mark B Ampode[1,4], Muhammad Ammar Dilawar[1,5], Hae-Rang Park[1], Il-Byung Chung[1], Young-Hwa Kim[6], Chul-Ju Yang[1,5*]

[1]Department of Animal Science and Technology, Sunchon National University, Suncheon 57922, Korea; [2]Department of Animal Nutrition, Sylhet Agricultural University, Sylhet-3100, Bangladesh; [3]Department of Multimedia Engineering, Sunchon National University, Suncheon 57922, Korea; [4]Department of Animal Science, College of Agriculture, Sultan Kudarat State University, 9800, Philippines; [5]Interdisciplinary Program in IT-Bio Convergence System (BK21 plus), Sunchon National University, Suncheon 57922, Korea; [6]Interdisciplinary Program in IT-Bio Convergence System (BK21 plus), Chonnam National University, Gwangju 61186, Korea.

† Both authors have contributed equally to the manuscript as co-first authors.

Abstract | The damage of crops by the wild pigs is an economic issue for agricultural sector. Therefore, it is necessary to identify the effective repellent for pigs. For this test, 6 pigs (Avg. wt. 66.03± 3.99 kg) were housed in an individual pen containing repellent and without repellent feeder. In this current study, a total six (6) ingredients (capsaicin, red chili, ground garlic, dead insects, denatonium benzoate, and thiophanate-methyl) were used as repellents. The repellent ingredients were used to hang over the feeders. Among the tested natural and chemical ingredients as a repellent, the average number of feeding approaches in repellent feeder was significantly lower ($P < 0.05$) in bitrex chemical (denatonium benzoate) and thiophanate-methyl chemical. No differences were noted in the number of feeding approach among the natural repellent, capsaicin, red chili, ground garlic, and dead insects (*Riptortus clavatus*). Moreover, there were no significant differences ($P > 0.05$) on the number of feeding approaches in the non-repellent feeder. The significant differences ($P < 0.05$) on feed intake were recorded in the repellent feeder. The lowest value was recorded in case of thiophanate-methyl repellent feeder ($P < 0.05$). A significant lower ($P < 0.05$) feed intake was noted in bitrex repellent feeder than the natural repellent ingredients (capsaicin and ground garlic and dead insects). However, as expected, no significant differences were noted on pig's feed intake in non-repellent feeders. Considering, the lower number of feeding approach and the lower feed intake in bitrex and thiophanate-methyl chemical as a repellent, we suggest performing further research with bitrex and thiophanate-methyl chemicals as repellent for pigs.

Keywords | Pigs, Repellent, Feed approaching number, Feed intake

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***Correspondence** | Chul Ju Yang, Department of Animal Science and Technology, Sunchon National University, Suncheon 57922, South Korea; **Email:** yangcj@scnu.ac.kr
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INTRODUCTION

Wild pigs (*Sus scrofa* L.) are reported to cause crop damage especially corn field damage in many countries (Anderson et al., 2016; Francesco et al., 2005), and such damage rate by wild pigs is increasing day by day. In addition, African swine fever is a fatal disease in pigs caused by the African swine fever virus that originated from wild

pigs (Denzin et al., 2020). The carcasses of wild pigs that usually get exposed to the crop land due to any accident or hunting activity by the human play as an important source of African swine fever (Denzin et al., 2020). To prevent the crop damage by wild pigs, different physical barriers, such as the electric fencing around the crop field or LED blinkers were established earlier (Francesco et al., 2005; Denzin et al., 2020). In addition, a few lethal elements were applied to prevent such type of crop damage. For example, some developed countries have applied toxic materials as pig's repellent (Shapiro et al., 2016). Ethically, those methods are prohibited due to the animal welfare issue (Dale and Dan, 1994). Furthermore, it causes a high risk of spreading the African swine fever from the dead carcass. All the physical barriers like electric wire fencing and lighting methods are expensive and need high maintenance costs (Francesco et al., 2005). Therefore, there is a necessity to identify the effective repellent for swine species. Now, farmers and related authorities are highly interested in efficient alternatives to the expensive and labor-intensive electrical fences (Schlageter and Daniel, 2012). Repellent products may act on taste, smell, or both senses. Those products have a scarce effect on the wild pigs or predator's attractiveness of food (Brown et al., 2000). Natural ingredients include red chili, capsaicin, ground garlic, dead insect (*Riptortus clavatus*), while the two chemicals include bitrex (denatonium benzoate) and thiophanate-methyl were used in this study. Red chili and capsaicin are generally irritants and could be applied to prevent deer browsing (Wagner and Nolte, 2000). Norinjae insects (*Riptortus clavatus*) can produce odor or specific pheromones which can be used as odor repellent (Maharjan and Jung, 2015). Bitrex (denatonium benzoate) is known as the most bitter component in animals (Francesco et al., 2005). Denatonium benzoate was applied in seedlings, and caring individual trees to prevent browsing by rodents, deer, and other wild animals (Shumake et al., 2000). Furthermore, bitrex chemical was also reported to be effective in reducing the damage to young olive trees by deer (Santilli et al., 2004). Methyl-anthranilate is known as a repellent and can prevent wild birds from grain consumption (Cummings et al., 1995). Those ingredients also can be used to eliminate the consumption of pelleted baits by birds but may risk of release the non-target hazards from granular pesticides to birds (Mason et al. 1993). However, no successful repellent has been identified for wild pigs to date. Also, limited investigations are available that compare the efficacy of natural ingredients and chemicals as repellent on the wild pigs.

Among the smart monitoring tools, video monitoring is the most popular technique practiced in modern swine farm (Mahfuz et al., 2022). With the help of video monitoring system, the behavior of individual pig and even a group of pig's behavior can be detected easily (Benjamin et al., 2019). Actual feed intake and the non- nutritive visit to feeders (only feed approach) are the most important parameters to determine the feeding behavior of animals (Miller et al., 2019). Data of feeding behavior can provide important information about the degree of feed rejection or actual feed intake by animals. Considering the above facts in consideration, this study aims to find out the natural and effective repellent ingredients for pigs, based on feed intake and the number of feeding approaches.

MATERIALS AND METHODS

Animals And Housing

The experiment was conducted at the Sunchon National University Experimental Pig Farm, Suncheon, South Korea. The trial comprised a total of 6 growing pigs having an average body weight was 66.03± 3.99 kg. The pigs were crossbred [(Duroc) x (Landrace White x Yorkshire)]. Care and handling of animals were conducted according to the Institutional Animal Care and Use Committee (IACUC), Sunchon National University, South Korea. Before starting the trial, all pigs were adapted for five days in the individual pens. Then the six pigs were raised in an individual pen with a measurement of 6.0 m (L) × 2.80 m (W) with two feeding troughs (feeders). About 30 g of each repellent ingredients and 9 insects were hanged over one feeder which was identified as repellent feeder. The other feeder was considered as a non-repellent feeder. The distance of two feeders were 3 m away. The trial was conducted for the same pigs, consecutively for 4 days (total 24 days) for each repellent ingredient with a two day's interval between two tests.

The pigs were housed in the monitored type growing shed with concrete flooring and good ventilation. The average housing temperature was 18.38°C, the relative humidity varied from 35.30 to 58 % (mean: 44 %), and the ammonia (NH_3) level was around 1.97 ppm. The housing temperature was determined using eight-bit Smart Sensors (model: SMT-75, Seoul, South Korea). The ammonia (NH_3) concentration was measured by installing a sensor-NH_3 3E 100 SE (City of Technology, Bonn, Germany) and installed inside the pig house at the height of 1.90 m at a range of 0-50 ppm (Mun et al., 2020).

Monitoring Of Feed Approaching Number

Camera was installed inside the pig's house for the real time monitoring of the feeding behavior of pigs and the feed approaching number. The camera was placed on an elevating bracket about 2.8 m off the ground, pointing downward to get a top view of the pen. To detect the most active time of pigs, real time video image was monitored by CCTV for 24 h during adaptation period. We noted that, the selected pigs were more active on feeding from 7.00

am to 9.00 am and at 2.00 pm to 4.00 pm. Therefore, we selected specific video monitoring time from 7.00 am to 9.00 am and from 2.00 pm to 4.00 pm to detect feed approaching number as feeding behavior. The pig was considered in an actual feeding practice when his head was inside a feeding trough. Each number of approach was counted only if pigs approached the feeding troughs and stayed for at least 20 sec. There were several studies where the feeding behavior of pigs was considered based on putting down the head (Lou et al., 1998), putting the head in the food area, biting, smelling and chewing food, and grubbing with snout inside the feeder trough (Lao et al., 2016; Maselyne et al., 2015).

Measurement Of Feed Intake

Feedstuffs were supplied daily into two feeders equally. The feed intake was calculated by subtracting the remaining feed from the supplied feed in a specific feeder every day.

Statistical Analysis

One-way analysis of variance (ANOVA) was applied via SPSS (2006). Individual pig was the experimental unit for trial. Tukey's multiple range test was applied to separate the statistical differences. Mean value and SEM were used to express results. Statements of significant level was as $P < 0.05$.

RESULTS AND DISCUSSION

The average number of feeding approaches by pigs in repellent and non-repellent feeders were presented in Figure 1. In the repellent feeder, the average number of feeding approaches was significantly lower ($P < 0.05$) in bitrex chemical (denatonium benzoate) and thiophanate-methyl chemicals than that of other tested groups. No differences were noted on the number of feeding approach among the natural repellent that includes capsaicin, red chili, ground garlic and dead insects (*Riptortus clavatus*). In the non-repellent feeder, there were no significant differences ($P > 0.05$) in the number of feeding approaches among the tested groups (Figure 1).

The effects of feed intake with and without the repellent feeder was presented in Figure 2. The significant differences ($P < 0.05$) in feed intake were recorded in the repellent feeder. The lowest value was recorded in case of thiophanate-methyl repellent feeder ($P < 0.05$). Lower ($P < 0.05$) feed intake was noted in bitrex repellent feeder than the natural repellent ingredients (capsaicin and ground garlic and dead insects). However, no significant differences were noted in feed intake of pigs in non-repellent feeders as expected.

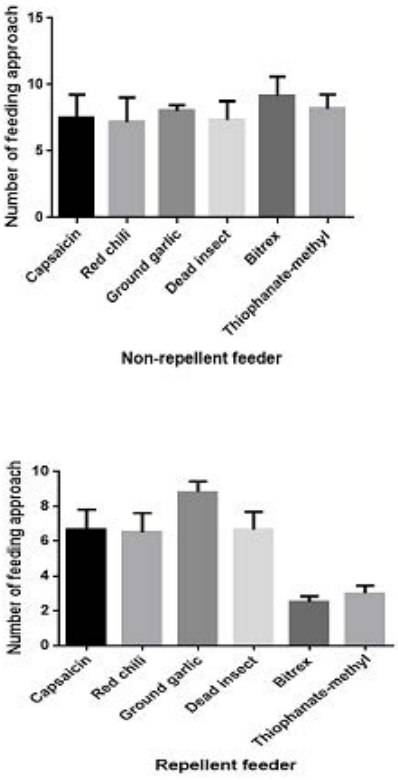

Figure 1: Average total number of feeding approaches by pigs in Repellent and Non-repellent feeder

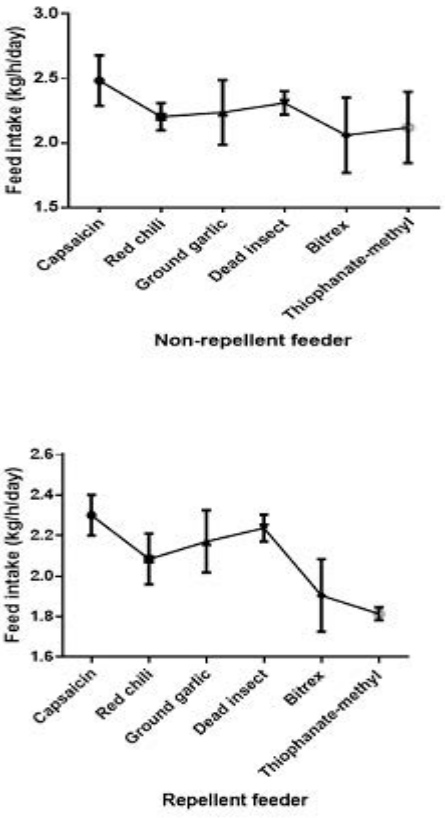

Figure 2: Average daily feed intake of pigs in Repellent and Non-repellent feeder

Individual pigs feeding or drinking behavior including

feeding time, visiting number of feeding troughs or drinkers etc. is measured by video monitoring as a tool of smart farming system (Andersen et al., 2014). As it is difficult to study with wild pigs, this study was designed to measure the feed approaching number with repellent feeder by domestic pigs. In a study by William et al. (1994), the mixture of hot sauces (capsaicin) was very effective to remove the wild deer from apple fields. Thus the same authors claimed that the capsaicin possesses repellent value for predator animals. Conversely, hot sauce failed to reduce corn consumption when added at 10 g/kg of corn, but the daily consumption was reduced by 80.5% at level of 25 g/kg (Francesco et al., 2005). Many naturally occurring bitter compounds are generally regarded as unpalatable and unpleasant (Garcia and Hankins, 1975).

Bitrex is an effective compound that could reduce the damage of olive trees by young deer (Santilli et al., 2004). The authors claimed that animals could not damage crops for the bitter taste of bitrex chemical. Thiophanate-methyl is popular for bird repellent. Cummings et al. (1995) reported that the application of thiophanate-methyl in seedling grains could reduce the damage consumed by birds which is in line of our findings for lower feed intake and lower feed approaching number in case of bitrex and thiophanate-methyl repellent feeder. In addition, Mason and Clark (1995) reported that thiophanate-methyl (a commercial product) prevents both crop loss and crop damage that caused by birds. Information about the dead insect (*Riptortus clavatus*) as repellent value in pigs is not available in literature. However, Maharjan and Jung (2015) indicated that norinjae insects produce bad odor representing repellent importance. The feed avoidance with the repellent feeder relates to the olfactory repellent effect. Lower feed approaching number and feed intake were found in repellent feeder while no differences in the number of feeding approach and feed intake by pigs in non-repellent feeders were recorded in this study.

CONCLUSION

Based on our findings, the bitrex (denatorium benzoate) and thiophanate-methyl had the repellent value for pigs. Considering the lower number of feeding approach and the lower feed intake in bitrex and thiophanate-methyl chemicals repellent feeder, we suggest performing further research with bitrex and thiophanate-methyl chemicals as a repellent for pigs.

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CONFLICT OF INTEREST

The authors claim that they have no competing interest.

NOVELTY STATEMENT

Till now, there is no effective repellent for pigs was identified. Thus, this study focused on finding the effective repellent for pigs that would be environment friendly.

AUTHORS CONTRIBUTION

All authors contributed equally in the planning of this study, conducting research, and drafting the manuscript. All of them approved the final version of the article.

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