Journal of Sustainable Veterinary & Allied Sciences
P-ISSN-2695-2661 e-ISSN: 2811-1346
JoSVAS 2023, Vol 4, Issue 2: 96-100
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Michael Okpara University of Agriculture, Umudike, Nigeria
Original research

Effect of oxpeckers' interactions on wounds healing process in calves at Federal University of Agriculture cattle production farm, Abeokuta, Southwest Nigeria

[1*]Abakpa, S.A.V., [1]Adeosun K.E., [2]Akintunde G.O., [1]Egbetade, A.O., [3]Olasoju M.I., [1]Alamu, A.O., [4]Idowu, K.R. & [1]Talabi, A.O.

[1]Department of Veterinary Medicine, [2]Department of Veterinary Physiology and Biochemistry, [3]Department of Veterinary Pubic Health and Preventive Medicine, College of Veterinary Medicine, [4]Department of Animal Production and Health, College of Animal Science, Federal University of Agriculture, Abeokuta, Nigeria

*Corresponding author: abakpasav@funaab.edu.ng , +2348032832801

ABSTRACT

This study investigated the role of oxpeckers in wound creation and healing in calves at the Cattle Production Venture of the Federal University of Agriculture, Abeokuta. Eleven calves with wounds out of twenty in the herd of 234 animals were randomly recruited for this study. Bates-Jensen wound assessment tool (BWAT) was used to assess the size, depth and edges of the wound, necrotic tissue type and tissue, exudate type and amount, skin colour surrounding wound, peripheral tissue edema and induration, granulation tissue and epithelialization to determine the severity. Descriptive statistics and ANOVA were used to analyse data obtained. Nine (81%) out of the 11 calves had more than one wounds. The score for all wounds decreased on day 15. The highest average score was 38.2 while the lowest was 17.8. The average score for each wound fell under wound status continuum. The highest percentage of reduction was 16.2% while the lowest was 0.9%. All wounds granulated at one stage or the other, except in one calf that did not throughout the study. Three calves had epithelialization above 75% on BWAT score of 2. At the termination of the study, 5 calves showed epithelialization of their wounds, 3 above 75% and 2 less than 50% while one wound did not epithelialize. In conclusion, wounds induced or exacerbated on calves by oxpeckers were under the status of continuum, and none neither regenerated nor degenerated. The activities of oxpeckers contributed to the delay in the wound healing process in the calves.

KeyWords: Calves, effect, Oxpeckers, wounds healing.

INTRODUCTION

The epidermis of mammals is a stratified epithelium with proliferative stem (progenitor cells) in the basal layer which maintains epidermal homeostasis and facilitates repair or regeneration (Hsu *et al.*, 2014). Wounds originating from the cutaneous tissue present a unique challenge whereby the epidermis must alter its proliferative, migratory, and differentiating dynamics to re-establish a functional permeability barrier. The overall process of adult wound healing occurs in multiple distinct but overlapping steps (Eming *et al*., 2014). Wounds can be caused by physical, chemical or biological agents (Majid *et al*, 2019). In calves, the major causes of wounds are penetrating horn injuries, stamping injury by mother or adult animal in a tightly packed animal barn, tightened nose rope, barbed wire injuries at brisket region, penetration of feet by sharp objects among others (Mohammed *et al*., 2019).

Wound healing is a complex, dynamic process supported by a myriad of cellular events that must be tightly coordinated to efficiently repair damaged tissue (Wilkinson & Hardman, 2020). The wound-healing process consists of four highly integrated and over lapping phases: homeostasis, inflammation, proliferation, and tissue remodeling or resolution (Gosain & DiPietro, 2004).

Oxpeckers (*Buphagus* spp) are small passerine birds restricted to Sub-Saharan Africa. They engage in a reputedly mutualistic relationship with the perrisodactyl (horses, zebras, rhinoceroses) and artiodactyl (deer, cattle) species of the African savanna. Oxpeckers provide a cleaning service by gleaning ectoparasites from their partners' hide (Plantan, 2009). Red billed oxpeckers (*Buphagus erythrorhynchus*) and yellow-billed oxpeckers (*Buphagus africanus*) are birds whose diet is almost entirely dependent on African ungulates. Oxpeckers consume the earwax, dung, urine, lice, mites, insects, scurf cells, hair and nose, eye and mouth

secretions of their hosts (Plantan *et al*, 2013). But ticks constitute the majority of the oxpecker diet, based on feeding observations and stomach content analyses of oxpeckers (Plantan, 2009). The outcome of inter- specific relationship can be strongly conditioned on the ecological setting in which it occurs, and the outcome can range from a strong to weak mutualism, to commensalism and even to parasitism. Spatial or temporal variation in the magnitude of either the costs or benefits of the interaction will influence the net effect for each partner (Plantan, 2009). To understand how interspecies interactions vary in space and time and move along the continuum, it is necessary to identify and quantify the costs and benefits to each partner species and to understand the mechanisms generating variation in those costs and benefits (Billick & Tonkel, 2003).

Oxpeckers do not always clean their hosts; sometimes they wound-feed from them (Plantan *et al*., 2013). They may inflict small wounds, open scars or use open wounds to consume tissue and blood (Samish, 2000). The percentage composition of their diet (wound, blood, tissue and scab material) is unknown because this behaviour has rarely been specifically examined (Weeks, 2000; McElligott *et al*., 2004). A wound-feeding oxpecker primarily, if not exclusively, inflicts a negative effect on the host animal. The wound may attract flies that can irritate the host and further exacerbates the wound (Plantan *et al*, 2013). This study assessed the wounds inflicted on calves and the effects of oxpecker interactions on the healing process.

MATERIALS AND METHODS

STUDY DESIGN

This study was conducted at the Cattle Production Venture of Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. Descriptive cross sectional design was used for this study. All calves in the herd were randomly examined for the presence of wound and Bates-Jensen wound Assessment Tool (BWAT) (Bates-Jasen *et al.* 2019) used to assess the healing process.

ASSESSMENT OF THE EFFECT OF OXPECKERS ACTIVITIES ON WOUND HEALING IN CALVES

Ethical approval was obtained from the Federal University of Agriculture, Abeokuta, College of Veterinary Medicine Ethical Committee (COLVETEC) (FUNAAB/COLVET/22/3791). The proposal was subjected to screening to ensure adequate care to the animals and appropriate standard animal welfare monitoring. A total of 20 calves in the herd were examined for the presence of wounds. Parameters were measured every 2 day in a week till the wound is healed. The size of the wound (length and breadth) were measured in centimeter by a ruler and multiplied to arrive at centimeter square after every oxpecker's activity. The depths of the wounds were also measured using rulers for the ones that were deep enough to be measured. Undermining was measured using a cotton wab stick inserted underneath the wounds to measure how far it can go and the distance was measured using a ruler and was recorded using BWAT guidelines. The type of necrotic tissues that are predominant in the wound according to colour, consistency and adherence was picked and recorded. The necrotic tissue amount was measured using ruler divided by the size of the wound and grouped into a quadrant of 25%, 50%, 75%, 100% or nil. The exudate type that was most predominant in the wound according to colour and consistency was recorded and grouped into bloody, sero-sanguineous, serous, clear purulent and foul smelling purulent. The amount of exudate was measured using eye test, whether the wound was dry, moist, wet, saturated or bathing the wound. Skin colour surrounding the wound was assessed by observing the colour of the tissues within 4cm of wound edge whether it was pink, bright red, white or black. Peripheral tissue oedema were measured by pressing a finger down into the tissues within 4cm of wound edge and waiting for 5 seconds, on release of pressure, tissues fail to resume previous position and an indentation appears.

Induration was assessed by pinching the tissues. Induration results in an inability to pinch the tissues. A ruler was used to measure how far the oedema or induration extends beyond wound. Granulation tissue was measured by how bright, beefy red, shiny and granular the wound surface or pale, pink or blanched to dull, dusky red colour. Epithelialization was measured by dividing a measured amount of epithelial tissue in the wound and dividing it by the total size of the wound and grouped into quartiles.

GENERAL SCORE FOR ALL WOUNDS ON THE BODY OF THE CALVES USING BWAT

Wounds on the body of the calves were evaluated two times in a week using Bates-Jensen assessment tool. A total score was given to each wound based on the severity of each of the parameters, with larger score size indicating severity or deterioration of the wound.

RESULTS

All the calves in the herd of 234 cattle were White Fulani cattle. Out of 20 calves in the herd, 11 (55%) were with one or more wounds on different regions of the calves' bodies. This comprised of 6 (63.64%) males and 5 (36.36%) females. The 95% confidence interval had a lower limit of 2.71 and upper limit of 8.14. There was significant difference in the BWAT score between day 1 and that of day 15 ($p = 0.003$). The BWAT score decreased by an average of 5.55 between Day 4 and Day 15 for all the animals studied. The 95% confidence interval had a lower limit of 2.82 and upper limit of 8.27 with significant difference on the BWAT score between day 4 and 15 ($p = 0.001$)

Figure 1: Photograph of Wound at the tail region of a calf (arrow)

Figure II: Photograph of Wound on the hip region of a calf (arrow)

Figure III: Photograph of wound on the scapula area of the calf (arrow)

Figure IV: Photograph of wound on the right flank of a calf (arrow)

There was a general decline in the score across the 15-day period. None of the wounds observed on days 1 – 15 was degenerative. They showed a significant decrease in their scores. Calves 6 and 11 had an insignificant decrease in their scores from 40 and 39 at the beginning to 38 and 35 at the end, respectively. At the end of the study (Day 15), the average BWAT score ranged from 17.8 in calf 1 to 38.2 in calf 6. There was no reduction in that of calf 4 with average score of 22. The highest percentage of reduction (16.2%) was seen in calf 5 while the lowest of 0.9% was seen in calf 2 (Table I).

GRANULATION PROCESS EXHIBITED BY THE DIFFERENT WOUNDS ON THE BODY OF THE CALVES

Wound on calf 1 exhibited evidence of granulation on days 1 to 3, lost it on days 4 and then, started again slowly from day 5 improving till day 15. The wounds on calves 2, 3 and 4

Table I: Wound healing process in calves based on BWART score

Days	Calf 1	Calf 2	Calf 3	Calf 4	Calf 5	Calf 6	Calf 7	Calf 8	Calf 9	Calf 10	Calf 11
1	20	21	34	22	29	40	21	29	37	24	40
2	21	25	34	22	28	40	21	29	37	23	40
3	22	27	36	26	32	38	23	32	36	23	40
4	21	24	36	26	30	37	23	32	36	23	39
5	20	23	30	23	28	36	21	32	35	23	39
6	20	23	30	23	26	36	21	31	35	23	39
7	14	17	23	21	22	39	22	31	35	23	39
8	15	17	22	21	20	40	21	31	34	21	39
9	15	16	23	20	21	40	21	29	33	19	39
10	13	16	21	23	21	40	21	30	33	19	34
11	18	18	21	22	21	37	19	30	33	20	34
12	18	17	21	21	21	37	19	30	33	24	34
13	17	14	21	20	22	37	15	29	30	24	35
14	17	14	24	20	22	38	15	29	30	24	35
15	16	14	24	20	22	38	15	28	30	24	35
Average	**17.8**	**19.1**	**26.4**	**22.0**	**24.3**	**38.2**	**19.9**	**27.9**	**31.5**	**22.5**	**37.5**
Reduction (%)	**11**	**0.9**	**22.4**	**0**	**16.2**	**4.5**	**5.2**	**3.8**	**14.9**	**6.3**	**6.3**

started granulating on day 5 and continued till day 15, with that of calf 3 doing better. Wound on calf 5 started granulating on day 2, lost it and started again on day 5 to day 15. Granulation tissues were seen in calf 6's wound from day 3 to day 15. Wound on calf 7 had granulation from the onset to day 5, but disappeared on day 6 to day 12 and started again till the end of the study. There was less than 75% of granulation in calf 8's wound on day 2 and remain the same with the wound being bright and beefy red all tthrough the study. Wounds on calves 9, 10 and 11 started granulation from day 3 (less than 25%) and remained so with the wounds being pink throughout the study period (Table II).

Table II: Level granulation process of wounds inflicted on calves

Days	Calf 1	Calf 2	Calf 3	Calf 4	Calf 5	Calf 6	Calf 7	Calf 8	Calf 9	Calf 10	Calf 11
1	1	5	5	5	5	5	2	5	5	5	5
2	1	5	5	5	3	5	2	3	5	5	5
3	1	5	5	5	5	2	2	3	4	4	4
4	5	5	5	5	5	2	2	3	2	2	2
5	4	3	2	2	3	2	2	3	2	2	2
6	3	3	2	2	2	2	5	3	2	2	2
7	3	1	1	2	2	2	5	3	2	2	2
8	1	1	1	2	2	2	5	3	2	1	2
9	2	1	1	2	2	2	5	3	2	1	2
10	2	1	1	2	2	2	5	3	2	1	2
11	1	1	1	2	2	2	5	3	2	2	2
12	1	1	1	2	2	2	5	3	2	2	2
13	1	1	1	2	2	2	3	3	2	2	2
14	1	1	1	2	2	2	3	3	2	2	2
15	1	1	1	2	2	2	3	3	2	2	2

Table III: Levels of epithelialization of wounds on calves on days 1, 4 and 15

Days	Calf 1	Calf 2	Calf 3	Calf 4	Calf 5	Calf 6	Calf 7	Calf 8	Calf 9	Calf 10	Calf 11
1	2	2	5	5	5	5	5	5	5	2	5
4	2	2	5	5	3	5	5	5	4	2	4
15	1	1	2	1	2	4	1	5	4	1	2

EPITHELIZATION OF WOUNDS ON CALVES ON DAYS 1, 4 AND 15 BASED ON BWAT SCORE

On day 1, calves 1, 2 and 10 had a BWAT score of 2 indicating 75% and above epithelialization of their wounds while calves 3 to 9 and 11 had less than 25% epithelialization. On day 4, the process remained the same in calves 1, 2 and 10 while that of calf 3 achieved less than 75% and that of calves 9 and 11 were less than 50%. At the termination of the study (day 15), wounds on calves 1, 2, 4, 7 and 10 had a complete epithelialization while, that of calves 3,5 and 11 were above 75%, 6 and 9 were less than 50%.There was no change in that calf 8 (Table III)

DISCUSSION

Oxypeckers were historically known to be in mutual relationship with cattle because they feed on ticks that infest on them (Nun *et al*., 2011, Welsh *et al*., 2018). However, recent activities of Oxpeckers have shown that the relationship extends to parasitism due to their wound feeding activities resulting in delayed wound healing, expansion of injuries and exposure of host to secondary infection (Adeyanju & Adejumo, 2019) and also evidence of resistance seen in ungulates (Bishop & Bishop, 2014). In this study, we observed the activities of oxpeckers and their effects on calves with wounds over a 15 – day period and discovered that some wounds were reopened and all failed to heal. All the average BWAT score of each wound fell under continuum status indicating that the wounds neither regenerate nor degenerate despite the fact that the average score at the end of the study was not higher than the onset which portends severity. The decrease seen in the BWAT score within 15 days of study indicated a fast healing process corroborating the report of Nooring *et al.* (2017), who reported that calves heal faster from wounds. However, this process could not achieve 100% success which could be attributed to the refreshing and reopening of the wounds by oxpeckers activities.

The prevalence of wounds created or exacerbated by oxpeckers on calves was high (55%) indicating a corresponding high activities of oxpeckers due to availability of source of food for their utilization as reported by various authors (Welsh *et al*., 2018; Adeyanju & Adejumo, 2022). The high activities of oxpeckers around the wound could also be attributed to absence of their primary source food emanated from regular tick control programme of the farm.

Granulation tissues are important components in the wound healing process. Granulation tissue may persist under several circumstances could be hypergranulation or prolonged granulation resulting from underlying conditions and/or errors in the stages of wound healing (Demidova-Rice *et al*.,

2012). In this study, most of the wounds initially showed poor granulation process, but all were able to generate granulation tissues at certain point in time. The granulation tissues were evidences of healing intentions of the wounds despite not achieving it at the end of the study. Hyper-granulation of wounds could be as a result of infection, excess inflammation, foreign body or physical irritation/friction (Guo & Dipietro, 2010; Pastar *et al*., 2014). In this study, all the wounds displayed evidences of hyper-granulation which could have been due to physical irritation and infections resulting from the activities of oxpeckers

The essential component of wound healing is epitheliazation and it is used as a parameter for the success of the process. No wound can be considered healed in the absence of epithelial tissues. At the end of this study, many of the wounds showed a good formation of epitheliazation except that they responded poorly and had complete absence in one. The failure or the delay of re-epithelialization in that particular calf might be caused by bacterial infection, tissue hypoxia, exudates, local ischemia, and excessive inflammation which might have impaired the pool of cells responsible for epithelialization as described by Menke *et al*. (2007).

CONCLUSION

Oxpeckers were consistently found around and feeding on wounds found on the calves. The healing process of the wounds were delayed, though BWAT score insignificantly decreased, complete healing was not achieved due to the constant wound feeding habit of the oxpeckers. The healing process was characterized by hyper-granulation and delayed re-epithelialization

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest

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