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The influence of mutual maternal and neonatal recognition on the foster mothering techniques in pigs

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Abstract

Mutual maternal and neonatal recognition vis-à-vis four foster mothering techniques were investigated using 32 sows and 128 neonate piglets in a four-week trial. The sows and the neonates were assigned into four foster mothering techniques designated as: Neonates rubbed with an odoriferous chemical and grafted during the day (NRD); neonates without the chemical treatment but grafted during the day (NWD); neonates rubbed with the chemical and grafted during the night (NRN) and neonates without the chemical treatment but grafted during the night (NWN). These four techniques were tested on four sets of sows comprising eight sows per set and four corresponding sets of neonate pigs comprising thirty-two neonate pigs per set on four different post-partum days (i.e. day 1 to 4 following farrowing). Total acceptance of the dam by the neonate gave a value of 54 with the probability of acceptance of 0.42, while total acceptance of the neonate by the dam was 86 with a probability of acceptance of 0.67. Total rejection and probability of rejection of the dam by the neonates were 74 and 0.58 with values of 42 and 0.33 for total rejection and probability of rejection of the neonates by the dam, respectively. The dams gave a higher percentage acceptance than the neonates while the neonates gave a higher percentage of rejection than the dam. Grafting within the first two days of life would hold a better fostering success on the part of the neonate as they showed more dependence on auditory and visual cues whose acuity may not have been well-developed within these first two days of life while the acceptance of the neonates by the dam could be enhanced by chemical masking of the olfactory cues, which the dam utilizes most for the recognition of her offspring.

Keywords: Foster mothering, mutual acceptance, mutual recognition, neonate pigs

Introduction

The whole gamut of production and reproductive success of livestock centred on the perception, recognition and management of all behavioural cues shown by the farm animals. This is more a truism when the maternal bond between the dam and her neonates is considered. McGlone (1991) summed up this assertion when he concluded that animals express feeding behaviour in order to gain weight and show sexual behaviour to procreate and that new studies like immunology and ergonomics have joined the studies of animal behaviour in fulfilling our objectives of complete understanding of environment and genotype and their interactions on which all aspects of animal productivity are hinged.

Fostering or grafting as a management technique has been practiced with varied level of success depending on the stockman's expertise on the techniques of disengagement and coupling of the aforementioned bond. This expertise warrants knowing the various visual, auditory and olfactory cues, the latency of development of such cues in the mother and her young, establishing the progression of such development for easy manouvrability in order to suit the whims and caprices of the stockman. Methods like slime grafting, chemical grafting and skin grafting have being in use for over a decade to facilitate foster mothering (Alexander and Stevens, 1982a, b; Price *et al.*, 1984; Basiouni and Gonyou, 1988; Snowder and Knight, 1995).

The success of any grafting technique is measured by the survival of the grafted subject beyond the weaning age. This success depends on many factors like breed, health and vigour of the neonate, maternal behaviour of the foster dam and her acceptance of neonate and the dam's milk production (Snowder and Knight, 1995). Castren *et al.* (1989b) in their study on the influence of housing on maternal-neonatal behaviour as it relates to nursing and teat order among piglets, concluded that unsuccessful nursing are common even in semi-natural environment and hence, should not be viewed as a symptoms of poor housing when found among confined sows and litters.

Much research efforts have been on the acceptance of the neonate on the part of the dam and this is apparent in researches conducted on ewes and their foster lambs. Price *et al.* (1984) reported that the age of the foster dam is not critical to the success of the odour transfer technique as alien lambs were still accepted at 12-17 days of age. This could be expected, as lambs are natural "followers" as opposed to the piglets that are neonatally "hiders". Mutuality of acceptance and rejection on the part of the foster dam and the grafted young has been an area of research where there is dearth of information till date. The objective of the present study therefore was to investigate mutual acceptance and rejection (mutual recognition) in pigs and their effects on the foster mothering techniques.

Materials and Methods

Experimental Site

This study was carried out at the Maternity Unit of the Piggery Section, Songhai Centre of Research and Experimentation, Porto-novo, Republic of Benin. The climate is of the hot, wet equatorial type with a bimodal rainfall pattern.

Experimental animals and their management

All the sows used for this experiment were in their second parity and were selected based on a minimum of six pairs of teats and a litter size of between eight and ten piglets. Each sow was housed in a pen measuring 2 x 10 m, supplied with in-built concrete watering and feeding troughs.

They were fed breeders ration made up of 15% crude protein and 2700 kcal ME/kg twice daily at 8 hours and 15.30 hours up till the third month of gestation, but were switched to the weaners ration of 19.75% crude protein and 2954 kcal ME/kg for the remaining three weeks of gestation in order to improve the quality of their feed preparatory to parturition and to enhance milk production during lactation. The sows were also fed this weaners diet throughout the lactation period to adapt the piglets to this feed.

Grafting techniques

The chemical grafting method was employed in combination with the transfer of the alien piglets to the foster dam either during the day or at night. This was compared with alien piglets not so

chemically treated but transferred at these two periods of the day to obtain four treatment techniques designated as follows: The first technique involved neonates that were rubbed with cotton wool soaked in kerosene and grafted during the day (NRD). In the second technique, neonates were not rubbed the odorous chemical but were grafted during the day (NWD). The third technique comprised neonates rubbed with kerosene but grafted during the night (NRN) while the fourth technique contained neonates that were not rubbed with kerosene but grafted during the night (NWN). The kerosene treatment was employed on both the alien piglets and those that truly belonged to the foster dam. These four techniques were repeated for the remaining three sets of experiment conducted for neonates at the second, third and fourth day of their parturition, respectively.

In the first set of the experiment, two sows each were allotted into these four techniques with four neonatal piglets grafted to each sow in a criss-cross manner. This pattern was followed at weekly interval for the second, third and fourth set of the experiment involving neonates that were grafted on the second, third and fourth day of their parturition respectively. Thus, the four techniques were tested on four sets of sows with their corresponding number of piglets as defined by the four different post-partum days at which grafting took place. Routine peri-natal and post-partum managements were carried out to ensure the welfare of both the dam and the neonates. This involved clipping of the canine teeth on the second day of farrowing, administration of iron dextran (Fercobsang at 2.50 ml/piglet) on the third day of birth, removal of faecal waste, washing and disinfection of the pens on a daily basis. Fresh feed and water for the sows were provided *ad libitum*. Mutual acceptance and rejection tests were carried out on the foster dams and the foster piglets. Acceptance of the alien piglets on the part of the foster dam was subject to the sow's reaction to them after observation for a maximum of five minutes. An alien was considered accepted by the dam if it was allowed to suckle without any untoward aggressive behaviour, if not it was considered rejected. Acceptance of the dam by the alien neonate was considered successful if it responds to the grunting calls of the sow or does not run away from her as she attempts to sniff it, if not she was considered rejected.

Statistical analysis

The number of alien piglets grafted or that failed to be grafted was collated per technique employed and per post-partum time interval and subjected to analysis using the χ^2 and Fisher extract analysis tests (Rosner, 2000). Mutual acceptance and rejection were tested for significance using t-test of SAS (2000) statistical package.

Results and Discussion

(a) Total number of piglets accepted and rejected with percentage and average acceptance and rejection for the different grafting techniques

Table 1 shows the number, percentage and average acceptance and rejection for the four foster mothering techniques employed. The values for total number of acceptance, percentage acceptance and average number of acceptance of the dam by the neonate were 10, 31.25% and 1.25 for the NRD group, 10, 31.25% and 1.25 for the NWD group, 18, 56.25% and 2.25 for the NRN group and 16, 50% and 2.00 for the NWN group, respectively, while the corresponding values for the acceptance of the neonates by the dams were 24, 75.00% and 3.00

Table1: Number, percentage and average acceptance and rejection per foster mothering technique*

Parameters	NRD	NWD	NRN	NWN
No of sows	8.00	8.00	8.00	8.00
No of piglets	32.00	32.00	32.00	32.00
No of acceptance (dams by neonates)	10.00	10.00	18.00	16.00
No of acceptance (neonates by dams)	24.00	14.00	24.00	24.00
No of rejection (dams by neonates)	22.00	22.00	14.00	16.00
No of rejection (neonates by dams) %	8.00	18.00	8.00	8.00
acceptance (dams by neonates) %	31.25	31.25	56.25	50.00
acceptance (neonates by dams)	75.00	43.75	75.00	75.00
% rejection (dams by neonates)	68.75	68.75	43.75	50.00
% rejection (neonates by dams)	25.00	56.25	25.00	25.00
Average value of acceptance (dams by neonates)	1.25± 1.09	1.25 ± 1.09	2.25 ± 1.19	2.00±1.33
Average value of acceptance (neonates by dams)	3.00±1.16	1.75±1.19	3.00±1.16	1.25±1.09
Average value of rejection (dams by neonates	2.75 ± 1.09	2.75±1.09	1.75±1.19	2.00±1.33
Average value of rejection (neonates by dams)	1.00±1.16	2.25±1.19	1.00±1.16	1.00±1.16

*The average values are given as: Mean ± S.E.M.

for the NRD group, 14, 43.75% and 1.75 for the NWD group, 24, 75.00% and 3.00 for the NRN group and 24, 75.00% and 3.00 for the NWN group, respectively.

The neonates rubbed with kerosene and transferred during the night gave the highest values of acceptance for these parameters. This unmasked the role of olfactory cues on the part of the dam and visual cues on the part of the neonate as the most important cues relied upon by the dam and the neonate for mutual recognition. Mutual acceptance would therefore increase if the foster dam could be made not to differentiate between the odour of the aliens and her true offspring coupled with grafting the aliens at night when they would be less active and unable to visualize the pen environment and the foster dam properly. This also brought to the fore the mental life of the neonates, i.e. their cognitive ability to infer the state of the dam. The high rate of success of acceptance recorded on day 1 and day 2 post-partum corroborated with the mental life postulates as reviewed by Heyes (1994), revealing the fact that the neonates were not mentally fully aware of their environment during the first two days of life. This was the best time of mutual acceptance between the neonates and their foster dams as far as this trial is concerned. This trend was also supported by the work of Basiouni and Gonyou (1988) who used birth fluids to confuse the dams into accepting alien lambs by rubbing them (the aliens) with her birth fluids.

The number of rejection per foster technique, the percentage rejection and the average number of rejection per sow has inverse relationships

with their corresponding acceptance values. These rejection values of the dam by the neonate were: 22, 75.00% and 2.75 for the NRD group, 22, 68.75% and 2.75 for the NWD group, 14, 43.75% and 1.75 for the NRN group and 16, 50.00% and 2.00 for the NWM group. The rejection values of the neonate by the dam gave: 08, 25.00% and 1.00 for the NRD group, 18, 56.25% and 2.25 for the NWD group, 08, 25.00% and 1.00 for the NRN group and 08, 25.00% and 1.00 for the NRN group, respectively.

The highest number of rejection of the dams by neonates (i.e. 22) was recorded for both the NRD and NWD groups where grafting was conducted during the day time, while the lowest number of rejection for this parameter (i.e. 14) was recorded for the NRN group. The NWN group gave a value of 16 for this parameter. The importance of these values is that grafting of neonate pigs would better be done during the night than during the day and that masking the odour cue of the dam at night would be beneficial because the NRN technique recorded the lowest number of rejection of all the four techniques investigated.

Maternal rejection of the neonates revealed that the highest number of rejection was recorded when the neonates were grafted during the day without masking the body odour of the alien piglets with kerosene. The intense sniffing of the neonates by the dam during the day and the increased mental awareness of the neonates beyond the second day post-partum accounted for this high number of rejection (18) of the neonates by the dam for this parameter (Plotkin, 1994). This parameter also showed that masking the odour of the aliens was only beneficial during the day (18 rejected on the NWD technique to only 8 for the NRD technique). Odour transfer during the night however did not affect the sensitivity of the dam to reject the aliens because the same numbers of rejections (8 neonates) were recorded for both the NRN and NWN groups, respectively. It would therefore be safer (health-wise to the neonates) and more cost effective to the livestock farmer to graft during the night without rubbing the neonates with odoriferous substances. This trial therefore revealed that maternal acceptance of the neonates through odour transfer is only beneficial during the day and not during the night as opposed to the work of Price *et al.* (1984) that concluded that odour transfer represents a relatively inexpensive and rapid technique to achieve maternal acceptance of alien lambs by post-partum ewes. The difference in the posturing of our trial with that of Price *et al.* (1984) could be as a result of difference in species of livestock used and the fact that our study demarcated between daylight and night grafting.

Estimate of the total number of acceptance of the dams by the neonates across all the techniques gave a value of 54 with a probability of acceptance of 0.42. The same calculation gave values of 86 and 0.67 for total acceptance and probability of acceptance of the neonates by the dams. The total number of rejection of the dams by the neonates across all the four techniques was 74 with a probability of rejection of 0.58 while total rejection of the neonates by the dams was 42 with a probability of rejection of 0.33, respectively. These figures showed that acceptance and hence the success of the foster mothering techniques was tilted more to the maternal side while rejection and hence failure of the techniques would have more contributions from the neonatal side. All these parameters were supported by Figure 1, which gave a graphic detail of percentage levels of acceptance and rejection according to the four foster mothering techniques employed. The highest percentage level of acceptance (75%) was recorded for

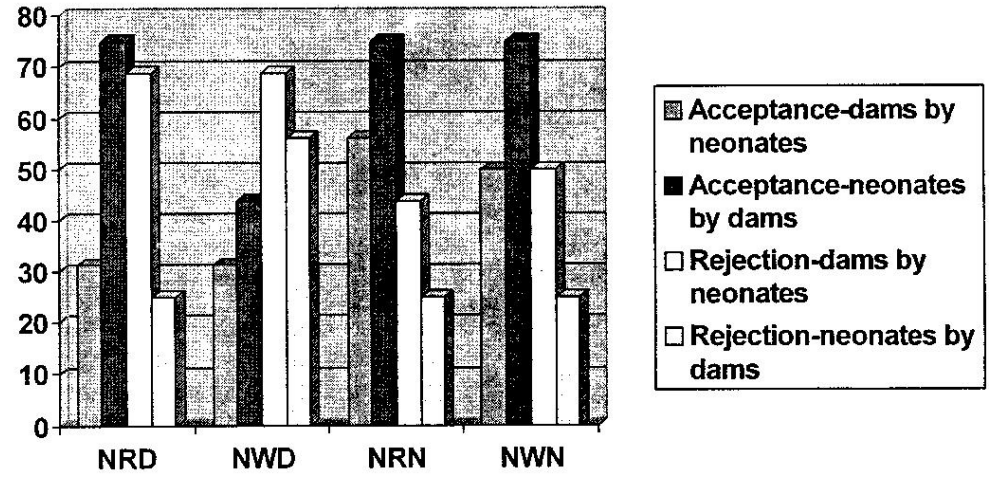

Fig. 1: Percentage level of acceptance and rejection between foster dams and grafted piglets per foster mothering techniques employed.

neonates by the dam in three of the four techniques investigated (NRD, NRN and NWN). It was only in the NWD that a lower value of 43.75% was recorded. This lowered value was not caused by the dam *per se* but by the increased cognitive awareness after day 2 on the part of the neonates that the foster mothers were not their true mothers and the increased tendency to run away from them as they approached to sniff them. This happened because the neonates at this time had started having a full visual awareness of their true dams with the whole accompaniment of their former pens and had started constructing a social niche around themselves as part of their learning processes. This observation was supported by the work of Odling-Smee (1994) who concluded that species have the tendency to carve out a niche for themselves as part of their learning behaviour. This figure also revealed the tendency of the neonates to better accept the foster dam during the night than during the day i.e. 31.25% for both the NRD and NWD as opposed to 56.25% and 50.00% for the NRN and NWN, respectively. This strongly supports the view that neonatal pigs rely more on visual than on olfactory or auditory cues.

The pendulum of rejection was also tilted more to the side of the neonates than to the dams. Inference from Figure 1 showed that rejection of the dam by neonate outweighed that of the neonates by the dam and that neonates showed more rejection of the dam during the day than at night. Rejection of the neonates by the dam was highest when neonates were transferred during the day without masking their odour with kerosene. This further lent credence to the reliance of the foster dams on olfactory cues for recognizing their offspring.

(b) Mutual acceptance and rejection per technique/group

Table 2 shows percentage mutual acceptance and rejection for the four foster mothering techniques studied. The gradation of mutual acceptance was

65.63% for the NRN group, 62.50% for the NWN group, 53.13% for the NRD group and 37.50% for the NWD group. This showed that mutual acceptance between the foster dam and foster piglet was highest when the neonates were rubbed with kerosene and grafted during the night and lowest when they were grafted during the day without the kerosene treatment. Grafting during the day with kerosene treatment was still lower than grafting during the night without the chemical treatment. This observation would then support the point that grafting could better be done during the night in order to reduce the cost of procuring this chemical and its possible deleterious effect on the tender skin of the neonates.

The values for mutual rejection were higher when grafting was done during the day than at night i.e. 46.88% and 62.50% for the NRD and NWD groups as opposed to 34. 38% and 37.50% for the NRN and NWN groups respectively, a pointer to the fact the foster mothering technique as far as swine production is concerned is favoured by night grafting. These rejection values were however on the high side for all the techniques because of the high cognitive ability of the neonates beyond Day 2 on the one hand and also as a result of the establishment of "teat order" after the second day of parturition on the other hand. (Morrow-Tech and McGlone, 1990) The establishment of the "teat order" often provoked fighting among the aliens and the "real" offspring, which usually aroused the curiosity of the foster dam and made her to sniff the aliens to make sure they really belonged to her. This would further make the aliens to be fretful of her especially when they were older than two days before being grafted.

(c) Acceptance and rejection based on the different post-partum days.

Figure 2 gives the percentage acceptance and rejection on the part of the foster dams and foster piglets based on the four different post-partum

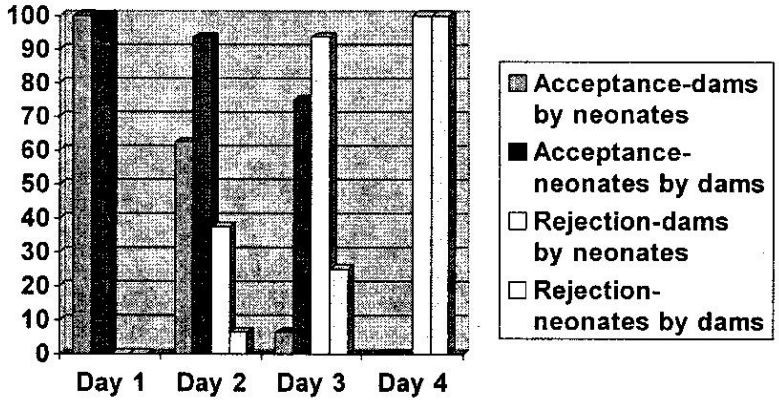

Fig. 2: Percentage acceptance and rejection between foster dams and grafted neonates for the four different post-partum days.

Table 2. Percentage mutual acceptance and rejection per group/technique*

Technique	Mutual acceptance	Mutual rejection
NRD	53.13	46.88
NWD	37.50	62.50
NRN	65.63	34.38
NWN	62.50	37.50
$\bar{X}$ ± SEM	54.69 ± 7.30	45.31 ± 7.30

*SEM = Standard error of the mean, abbreviations are as defined within the text.

days at which grafting took place. The first day post-partum recorded 100% acceptance and zero percent rejection on the part of the dam and foster piglets for each other. The implication of this is that fostering of piglets to their would-be foster dams is best on the first day of farrowing. This is because at this first day, the sows were still lethargic and lay down most of the time as a result of the rigour of parturition they have just gone through. That is why many sows show clumsiness around this time with a high tendency of lying on their piglets (Blackshaw and Hagelso, 1990), the neonates on their part were still not fully mentally aware of the sows and the environment and were still undergoing the learning process of registering the perception of the sow's grunting calls in their brain. (Hogan, 1994; Berridge, 1994). At this point, it would still be very easy to erase and switch over to another grunting call.

Grafting on the second day post-partum revealed that acceptance of the dams by the neonates had dropped to 62.50% while that of the neonates by the dams had dropped to 93.75%. Also 37.50% rejection was caused by neonates running away from the foster sows while sows showing aggressive behaviour to the alien piglets caused 6.25% rejection. This showed that at day 2 post-partum, the mental alertness of the neonates has been switched on and some of them could now visualize and register the notes in the grunting calls of their true mothers from those of the "strange" dams. The level of rejection recorded on account of the foster dams on the second day of post-partum was through foster mothering in the daytime without the kerosene treatment to mask the odour of the alien neonates.

When grafting was delayed until the third day of parturition, there was a drastic reduction in the acceptance level of the dams by the neonates (6.25%) coupled with a correspondingly high rejection level (93.75%). However, seventy-five percent (75%) of the sows were still able to accept the aliens up to the third day of parturition, a corroboration of the fact the neonates themselves contribute to a high percentage of rejection between them and the foster dams through their rapid rate of mental alertness and visual acuity of their immediate environment as part of their learning behavioural processes, (Hogan, 1994; Berridge, 1994). Grafting on the fourth day of parturition showed zero percent acceptance and 100% rejection between the foster dams and the neonates. On day 4, the neonatal piglets were no longer fooled by the day or night grafting as they were now mentally aware of their pen's environment and were now able to draw a sharp distinction between their mothers' calling grunts and those of strange mothers and were also able to register the visage of their true mothers distinctly. Though some sows were still being deceived by the kerosene treatment and night grafting, acceptance was made impossible by the reactions of the alien

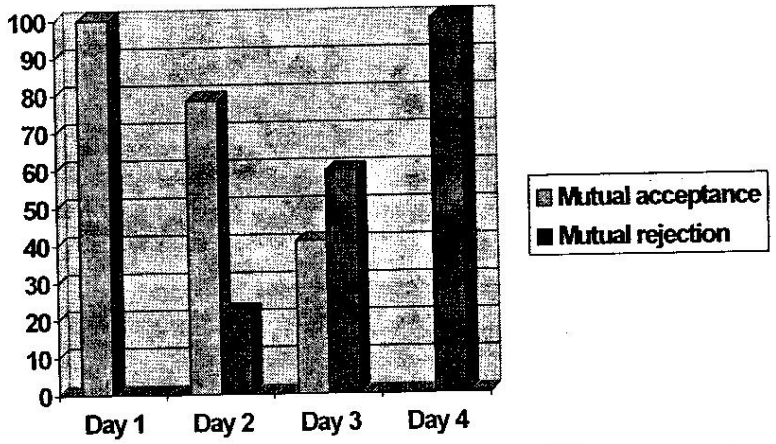

Fig. 3: Percentage mutual acceptance and rejection for the different post-partum days.

piglets by way of distinct distress calls, their self seclusion from the piglets that belong to the foster sows and running away from the foster sows. All these helped to arouse the sensitivity of the foster sows to know that these piglets were aliens with the concomitant elicitation of aggressive and violent reactions towards them.

(d) Mutual acceptance and rejection for the different post-partum days

Figure 3 gives the percentage mutual acceptance and rejection for the four post-partum days investigated. Mutual acceptance dropped from 100% when grafting was done within the first day of parturition to 78.13% on the second day, to 40.63% on the third day and finally to zero percent on the fourth day. Mutual rejection in a reverse order rose from zero percent on the first day to 21.88% on the second day, to 59.38% on the third day and to 100% on the fourth day, respectively. The graph (Figure 3) also revealed the inverse relationship between mutual acceptance and rejection. A closer look at the graph showed that the gradients changed beyond day 2 and became steeper henceforth, meaning that the first day would afford the greatest manouvrability of grafting between the sows and the neonates beyond which it becomes riskier and more difficult to practice. The reason for this decrease in mutual acceptance as the post-partum days became elongated was to a greater extent due to increased mental and visual acuity of the neonates as the days progressed and to a lesser extent to the olfactory cues relied upon by the foster sows to identify alien piglets.

Conclusion

Conclusively, this study revealed that foster mothering in pigs is better practiced within the first day of parturition and should not go beyond the second day if any appreciable level of success is to be recorded. It also showed that the success of foster mothering techniques depends more on the acceptance of the dam by the neonate and not vice versa as far as neonate pigs are concerned. More light was shed on the odour transfer technique of foster mothering in that it was made manifest that the use of odoriferous substances on the neonate would only be necessary if grafting is to be done beyond the first day post-partum and more so during the day, since there is very little difference between

levels of acceptance when grafting is done during the night with or without kerosene treatment.

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