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SURVEY OF CHEMICAL DISINFECTANTS USED BY POULTRY FARMERS IN IMO STATE, NIGERIA

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ABSTRACT: *Pathogen contamination can be prevented with aid of proper health care products such as disinfectants. This study was designed to evaluate the efficacy of common disinfectants and disinfection practice of poultry farmers in Imo State, Nigeria, in order to generate information needed for the proper regulation of disinfectant use in the area. Primary data were generated from structured questionnaires distributed to animal health practitioners and poultry farmers in the State. Results showed that farmers choice of disinfectants were dependent on cost and availability. Z-germicide® 10 (22.27%) and Izal® with 9 (20.45%) are more widely distributed in the various animal health outfits. This was closely followed by Lysol® 6 (13.63%) and Diskol® 6 (13.63%). Morigard® 3 (6.81%), Dettol® and Septol® 3 (6.81%) appeared each in three outfits. Vox® 1 (2.27%) CID 20® 1 (2.27%) a Virkon® 1 (2.27%) occurred once and that is at the Avian influenza desk officer's store. Izal® 140 (58.82) was more widely used by farmers followed by Z-germicide®, both of which are phenolic products. Morigad® with 2 (2.94%) and Lysol® with 91.47%0 are also phenolic products. Altogether 76.47% of disinfectants used in Imo State were of phenolic products. Most poultry farms in the State did not use disinfectant footbath. Those that used them did not insist on workers or visitors dipping their feet in them before entering the farm house. They also did not reconstitute the disinfectants according to the manufacturer's instructions.*

Keywords: *Disinfectants, poultry farms, disease, Nigeria*

ORIGINAL ARTICLE

INTRODUCTION

Intensive poultry farming provides optimum conditions for the concentration of pathogens and transmission. The crowding of thousands of birds in an enclosed warm and dusty environment is highly conducive for the transmission of contagious diseases (Collins, 2007). Furthermore, selection of birds for faster growth rate and higher meat yield has left the birds immune system less able to cope with infections and there is a high degree of genetic uniformity in the population, making spread of disease all the more easy (Delany, 2003). The presence of these diseases has created the need for the control of poultry pathogen in the intensive farming system.

Microbiological contamination can be prevented and controlled using proper management practices and healthcare products such as disinfectants (MSU, 2008). The main purpose of disinfectant action is to reduce the number of pathogen in the environment. By reducing pathogen numbers, the potential for disease occurrence in the poultry farm is reduced (Block, 2001). The mode of action of the disinfectant chemicals is usually to disrupt significant cellular structures or processes in order to kill or eliminate the microorganisms (Allen and White, 2006).

Generally, a commercially available disinfectant will exhibit the ability to reduce microbial contamination by several orders of magnitude in a standard test method in order to be approved for use. In use in farms however, not all disinfectants exhibit the activity that one would expect on standard tests (HACCP Manual, 2008).

According to records from the zonal veterinary Clinic Owerri, Imo State (Chima, personal communication) there are several cases of disease outbreaks in many poultry farms even, when the farmers claimed to have used disinfectants to prevent such disease outbreaks. Farmers may therefore be spending their money on available disinfectants without commensurate results. There may also be inherent problems arising from poor prescription practices of skilled and unskilled animal health practitioners in the area (Okoli et al., 2002). There is therefore the

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need to generate reliable data on the disinfectant use practices of poultry farmer in the study area, since such information will aid formulation of regulatory frameworks for the development of appropriate biosecurity schemes.

The objectives of this study was therefore to determine the types of disinfecting agents prescribed by animal health practitioners, the types utilized by poultry farmer as well as the disinfection practices of farmers in Imo State.

MATERIALS AND METHODS

The study area

The study was carried out in the three geo-political zones of Imo State, which is situated in South-eastern agro-ecological zone of Nigeria. Poultry production in the area has been described by Okoli (2004). The farming operations are distributed over urban, peri-urban and rural sites and have been shown by Okoli (2004) to range from very small operations (50-100), to medium (101 to 1000 birds) and large scale (above 1000 birds).

Identification and selection of animal health outfits/farms

A two-week preliminary field investigation was carried out to identify animal health practice outfits and farms that will be sampled. During this survey, researcher made her self-known to the poultry operators and their managers and discussed the detailed nature of the work with them.

The main study, which, consisted of two phases (survey/evaluation) covered the three geo-political zones of the states, Owerri, Orlu and Okigwe. The urban centers in each zone were purposively included. The study sites selection covered all the animal health practice outfits and some large-scale and small-scale farms in the state. The preliminary field investigation revealed that there were more commercial farms in the Owerri geo-political zone. Based on this information, 40 farms were selected from Owerri zone, 30 farms from Orlu zone, and 20 farms from Okigwe zone. Altogether 90 farms were surveyed. Selection of these farms was based on the membership list of the state branch of the Poultry Association of Nigeria. The list of 227 members was first divided into geo-political zones and thereafter, farms in each zone were grouped according to their scale of operation as stated earlier. The farms were then randomly selected for the survey.

Furthermore, six farms for on-farm disinfection study were randomly selected, (two farms from each zone). Specifically, one large-scale farm and one small-scale farm were selected from each geo-political zone.

The large-scale farm in Owerri zone is located at Naze in Owerri West LGA. It has been in existence for about 20 years and currently stocks about 10,000 birds of different strains and ages, housed in four separate buildings. About 8,000 birds are reared on battery cage, while another 2000 birds are reared on deep litter. The feed for the birds are sourced from commercial feed manufacturers, while a borehole in the farm supplies water for the birds.

The small-scale farm from Owerri zone is located at Egbu Road in Owerri North LGA. It is a demonstration farm belonging to Imo State Livestock Development Project. The farm has been in operation for more than six years and presently stocks about 600 birds, (200 broiler and 400 pullets) in two separate buildings in the farm. The birds are reared on deep litter. The feed for the birds is sourced from commercial feed dealers, while water is supplied from a private borehole in the farm.

In Orlu geo-political zone, the larger-scale farm selected is located at Okwu Abala in Orlu LGA. The farm has been in existence for about five years. The farm houses about 2000 laying birds in two building. Each building is partitioned into four pens with wire gauze. The birds are reared on deep litter. Both feed and water for the birds are sourced from commercial feed and water dealer respectively.

The small-scale farm from Orlu zone is located at Ihioma. It has been in existence for about four years. There are about 800 birds reared on deep litter in a single structure at the back of the operator's house. The structure is divided into four pens, with short wire gauze. Feed and water for the birds are sourced from commercial dealers.

In Okigwe geo-political zone, the large scale farm selected is located at Umulolo along Okigwe-Enugu express road. The farm has been in existence for about ten years, and currently houses about 6500 birds in four separate buildings and reared on deep litter. About 5,000 out of the 6,500 birds in the farm are laying. The farm belongs to an animal health practitioner, who compounds the feed for the birds. Water for the birds is sourced from a private borehole in the farm.

The small-scale farm in Okigwe geo-political zone is located at Ubahu Okigwe. It has a bird population of about 930, housed in one long house divided into five pens with dwarf wall and wire gauze. The bird population is made up of about 120 broilers and 800 laying birds reared on deep litter. Feed is sourced from commercial feed dealer, while their drinking water is from water hawkers and a nearby stream.

Survey of animal health business practitioners

This was carried out with the; objective of determining the types of disinfecting agents sold or prescribed by them. Two visits were made to all the animal health practice outfits in Owerri, Orlu and Okigwe Urban centers. During the first visit, structured questionnaires were distributed to the owners of the outfits that sell disinfectants to the farmers and second visit, the questionnaires. The completed questionnaires were retrieved. The questionnaire responses was collated and analyzed with frequency distribution. A sample of the questionnaire is shown in appendix 1.

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Survey of poultry farmers

A survey of selected poultry farmers to determine the types and volumes of disinfectants utilized by poultry farmers in Imo State and to determine the disinfection practices of poultry farmers in Imo State.

Selection of the study farms was based on the membership list of the state branch of the poultry Association of Nigeria as stated earlier. The 227 membership list was divided into the three geo-political zones and thereafter 40 farms from Owerri, 30 farms from Orlu and 20 farms from Okigwe (totaling 90 farms) were selected. The study farms were randomly selected using the restricted shuffled approach (Schutz and Grimes, 2002). This was done by writing name of each of the farm in each geo-political zone on a single card of similar size and color. The cards were shuffled thoroughly to mix them, and then spread out on a table with their faces downwards. A volunteer was asked to pick one card each from the packs belonging to each geo-political zone. This was repeated until the desired numbers of farms were selected for each zone.

Again, two visits were made to each of the selected farms, first to distribute structure questionnaires and secondly to collect the responses. Responses were collaborated with on-site observation.

Statistical analysis

The questionnaire responses were collated and analyzed using frequency distribution.

RESULTS AND DISCUSSION

The activities of animal health practitioner (AHP) in Imo state

Results of the survey of animal health practitioners in Imo State are highlighted in table 1-4. Table 1 revealed that Z-germicide® 10 (22.27%) and Izal® with 9 (20.45%) are more widely distributed in the various outfits. This was closely followed by Lysol® 6 (13.63%) and Diskol® 6 (13.63%). Morigard® 3 (6.81%), Dettol® and Septol® 3 (6.81%) appeared each in three outfits. Vox® 1 (2.27%) CID 20® 1 (2.27%) a Virkon® 1 (2.27%) occurred once and that is at the Avian influenza desk officer's store.

Table 1 - Types of disinfectant stocked by animal health practitioners in Imo State

Disinfectants	Frequency	Percentage
Z-germicide®	10	22.72
Izal®	9	20.45
Diskol®	6	13.63
Lysol®	6	13.63
Morigard®	3	6.81
Dettol®	3	6.81
Septol®	3	6.81
Trisept®	1	2.27
Vox®	1	2.27
CID 20®	1	2.27
Virkon®	1	2.27
Tota	44	100

Source: Filed data 2009.

This is expected since phenol in the form of carbolic acid is the oldest known chemical disinfectant and has been shown to have many advantages over other type of disinfectants including being readily available, is cheap and easy to dispense among many other properties.

Table 2a showed that demand of a particular disinfectant by the farmers (54.05%) mostly influence disinfectant stocking pattern in the animal health outfits. This was followed by the disinfectant availability (29.72%) and professional choice of disinfectant (16.21%). It is clear from the results that the availability of a particular disinfectant in an animal health outfit in Imo State is driven by the farmer's choice and not the professional's choice of the practitioner. This agrees with the general picture of drug abuse previously reported in the management of antibacterial products in Nigeria and other developing countries (Okeke et al., 1999; Okoli et al., 2002).

Table 2b showed that (66.66%) of animal health practitioners prescribe to farmers disinfectants for use in their farms. Most often, their prescription is based on what is available in their outfit and not in efficacy, as highlighted earlier in table 4.2a. The complication of such poor management of antibacterial drugs is counterproductive and has been complicated in the very high resistance of common microorganisms to available antibacterial in the study environment (Okoli et al., 2002; Okoli, 2004).

Table 3a showed that majority of the poultry farmers (66.66%) accepted the disinfectants prescribed by the animal health practitioners for use in their farms. The (33.33%) non adherence to the prescription of animal health practitioners as observed in this study is of both economic and public health implications since such behaviors have been shown to be a contributory factor to the already stated development of acquired bacterial resistance in Nigeria and other developing countries (Okoli et al., 2002).

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Table 3b revealed that (83.33%) of the interviewed animal health practitioners stated that farmers chose a particular disinfectant for use based on its cost; as against availability and colleague influence (8.3% each). It would seem then that Z-germicide® and Izal® which is phenolic compound are not only the most readily available but also the cheapest in the study areas. The cost may not necessarily be a factor of the disinfectant quality but also that of the nature of packaging and presentation.

Table 2 - Disinfectant stocking determinants and prescription frequency among animal health practitioners

Items	Frequency	Percentage
(a) Disinfectants stocking determinants (n = 37)		
Determinants		
Demand	20	54.05
Availability	11	29.72
Professional choice	6	16.21
Total	37	100
(b) Disinfectant prescription frequency (n = 24)		
Disinfectant Prescription		
AHP that prescribe to farmers	16	66.66
AHP that do not prescribe to farmers	5	20.83
AHP that prescribe sometimes	3	12.50
Total	24	100

Source: Filed data 2009.

Table 3 - Farmers adherence to prescription and determinants of disinfectant choice by farmers

Items	Frequency	Percentage	
(a) Farmers adherence to prescription (n = 24)			
Farmers Adherence			
Farmers that adheres to prescription		16	66.66
Farmers that do not adhere to prescription		8	33.33
Total		24	100
(b) Determinants of farmer's choice of disinfectants (n - 24)			
Determinants			
Cost		20	83.33
Available		2	8.33
Colleague influence		2	8.33
Total		24	100

Source: Filed data 2009.

For example, there may be smaller packs of these products which bring them within the purchasing power of the farmers, who have been shown to be mostly small holders (Anyaegbunam, 2003; Nwaodu, 2005).

Table 4 Revealed that majority of the outfits (70.83%) do not keep records of the volume of each disinfectant sold, while 29.66% kept records of their sales. This result is of grave economic and animal health importance since lack of such information reflects the poor organizational structures of animal health business enterprise in Nigeria.

Table 4 - Availability of sales record on disinfectants in the health practice outfit

Sales record keeping	Frequency	Percentage
Available record	17	70.83
Non Available record	7	29.16
Total	24	100

Source: Filed data 2009.

Over the last decade, significant proportion of veterinarians are in private practice, however, Okoli et al. (2002) showed that out of 158 animal health outfits studies in South Eastern Nigeria, only 48 (30.4%) were manned by skilled veterinarian while a major 69.6% was manned by non-descript traders and non by pharmacists.

In Owerri specifically, the 21.9% recorded was significantly lower than the regional average. It is therefore probable that the preponderance of this group of untrained animal health practitioners in the study area is contributory to the observed poor records keep culture.

The survey of the animal health practice outfits showed that Izal® and Z-germicide®, which are phenolic products, are more widely distributed in the outfits that sell disinfectants. The other products that are next to them in distribution are all phenolic products also, with the exception of Diskol®, which is a glutareldehyde. The least in distribution are Virkon® (Oxidizing agent), Vox® (Halogen product) and CID 20®, which has a mixed active ingredient (quaternary ammonium compound, aldehyde and alcohol).

Virkon®, Vox® and CID 20® were not found in the commercial outfits but were the disinfectants being distributed to the farmers by Federal Livestock Department through the desk officer of Avian Influenza project, Owerri, Imo State. Though the animal health practitioners prescribe to farmers the disinfectant to buy, farmers

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choice of disinfectants still determines what they stock in their outfits. The farmer's choice of disinfectant was over 80% dependent on cost as could be seen from the survey. This explains why they prescribe and sell more of Izal®, which is cheaper than the other disinfectants to farmers.

The activities of poultry farmers in Imo state

Table 5 revealed the socio-cultural characteristics of the farms studied in Owerri, Orlu and Okigwe zones of Imo State. There were more farms at Owerri than Orlu and Okigwe. Sixty percent of the farmers were males and fell within the 41 to 50 years age bracket, with 44 (48.88%) having attended tertiary institutions. Most of these farmers (93.3%) were married.

Table 5 - Social characteristics of farmers (n = 90)

Social Characteristics		Frequency	Percentage
(a)	**Location of farm**		
	Owerri	40	44.44
	Orlu	30	33.33
	Okigwe	20	22.22
	Total	90	100
(a)	**Sex of Farmers**		
	Male	54	60
	Female	36	40
	Total	90	100
(c)	**Age of Farmers**		
	Below 20	0	0.0
	21-30	0	0.0
	31-40	21	23.33
	41-50	42	46.66
	51-60	17	18.88
	Above 60	10	11.11
	Total	90	100
(d)	**Marital Status**		
	Married	84	93.33
	Single	6	6.66
	Total	90	100
(e)	**Educational Qualification**		
	Non formal education	4	4.44
	Primary	8	8.88
	Secondary	34	37.77
	Tertiary	44	48.88
	Total	90	100

Source: Filed data 2009

Anyaegbunam (2003) and Nwaodu (2005) have reported similar results for the different sectors of the livestock industry in Imo State. Usually these smallholder farmers are civil servants, married and having moderately large families of 4-6 persons. They use different forms of livestock farming to augment their incomes (Anyaegbunam, 2003).

Table 6a revealed that 50 (58.55%) of farms were mixed broilers and layer farms. On-site observation showed that the 16 (17.77%) that rear only broilers were mainly small sized farms with birds under five hundred in number, while those that reared only layers were mainly large-sized farms with birds above two thousand in number. Table 6b showed specifically, the small sized and large sized farms were 32 (35.55% each) while the medium sized farms were fewer in number (28.88%).

Table 4.7 revealed (a) the pattern of disinfectant use in farms, (b) presence of disinfectant footbath in farm and (c) availability of disinfectants in the footbath. Table 7a revealed that 68 (75.55%) of the farms surveyed use disinfectants, while 22 (24.44%) were not using disinfectants. On site observation showed that the farms that do not use disinfectants are mainly the small sized farms that keep only broilers and cockerels.

Table 7b revealed that 50 (55.55%) of the farms had footbath at the entrance of poultry pens while 40 (44.44%) did not have footbath in the farm. Table 7a showed that 68 (75.55%) of farms use disinfectants, this indicates that some farms that did not have footbath still use disinfectants for other purposes. On site observation showed that some farms, pour disinfectants in folded sac bags placed at the entrance to the poultry house. This, they use as improvised footbath. Such practices reflect gross ignorance of the actual functions of a disinfectant footbath in a farm (WHO, 1994).

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Table 6 - Types of poultry farms and size distribution of farm		
Items	**Frequency**	**Percentage**
(a) Types of Farm		
Broiler	16	17.77
Mixed (broiler/layer)	50	55.55
Layer	24	26.66
Total	90	100
(b) Farm Size		
Small size (less than 500 in number)	32	35.55
Medium sized farms (500-1000 birds)	32	28.88
Large farms (above 1000 birds)	26	35.55
Total	90	100

Table 7 - Pattern of disinfectant use, presence of disinfectant footbath in farm and availability of disinfectants in the footbath		
Items	**Frequency**	**Percentage**
(a) Use of disinfectant		
Farms that use disinfect	68	75.55
Farms that do not use disinfectant	22	24.44
Total	90	100
(b) Presence of disinfectant footbath		
Farms with disinfectant footbath	50	55.55
Farms without disinfectant footbath	40	44.44
Total	90	100
(c) Availability of disinfectant in the footbath		
Disinfectant always available in the footbath	30	44.11
Disinfectant not always Available in the footbath	38	55.88
Total	68	100
Source: Filed data 2009.		

The presence of a footbath at the entrance of a poultry house may not mean that disinfectants are in them, thus table 4.7c. Table 4.7c showed that only 30 (44.11%) of farmers were constant in their use of disinfectant in the baths, while 38 (55.88%) use disinfectant only when it is available in the farm. On site observation showed that, the farmers that were consistent with disinfectant use were mainly the large sized farms that rear layer.

Table 8 showed that the types and frequency of use of different disinfectant brands in the study area. Izal® 140 (58.82) was more widely used by farmers followed by Z-germicide®, both of which are phenolic products. Morigad® with 2 (2.94%) and Lysol® with 91.47%0 are also phenolic products. Altogether 76.47% of disinfectants used in Imo State were of phenolic products.

Table 8 - Types of disinfectants used in farms		
Disinfectant	**Frequency**	**Percentage**
Izal®	40	58.82
Z-germicide®	9	13.23
Diskol®	6	8.82
CID 20®	3	4.41
Vox®	2	2,92
Virkon®	5	7.35
Morigad®	2	2.94
Lysol®	1	1.47
Total	68	100
Source: Filed data 2009.		

Again Table 9a showed that 40 (58.82%0 of the poultry farmers were using disinfectants that were readily available than those prescribed for them by the animal health practitioner (8.82%). Previous experience with the product and cost also played minor roles (17.64% and 14.70% respectively) in the farmer's choice of the disinfectant.

Table 9b on the other hand showed that the decision on the types of disinfectants to use in farms in the study areas was evenly distributed among farm managers, animal health practitioners and farm owners. This is in agreement with the earlier results in table 4.3b that 66.66% of farmers accept the prescription of the animal health practitioners; it is probable that these are mostly the owners and managers of the larger layers farms.

Table 10a revealed that 40 (58.82%) of farmers reconstituted the disinfectants as desired, while 28 (41.17%) adhered to the instructions given by the manufacturers. On site, observation showed that farm workers, who reconstitute the disinfectants, do not bother to read the instructions before reconstitution of the disinfectant. Similarly, table 4.10b showed that majority (58.82%) of the farms change the reconstituted disinfectant in the

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footbath every other day. From onsite observation, it was discovered that almost all the farms visited change the disinfectant more out of desire than what the manufacturers recommends.

Again table 10c showed that 30 (44.11%) of farms insisted on their workers and visitor's use of footbath, while 38 (55.885%) of farms do not insist on their workers and visitors use of footbath on the farm. These results again highlight the gross ignorance on the part of these farmers on the actual functions of disinfectants on intensive farming of poultry. Different level of such poor use of antibacterial, which leads to antibacterial resistance, has also been reported among skilled and unskilled veterinarians in the study area (Okoli et al., 2002).

Table 9 - Determinants of farmer's choice of disinfectants and decision on the disinfectant to use in the farm

Determinants of farmers choice	Frequency	Percentage
(a) Availability	40	58.82
Prescription	6	8.82
Previous experience	12	17.64
Cost	10	14.70
Total	68	100
(b) Who decides disinfectant to use		
Farm manager	24	35.29
Animal health practitioner	22	32.35
Farm owner	22	32.35
Total	68	100

Source: Filed data 2009.

Table 10 - Reconstitution practice of farmers, frequency of change of reconstituted disinfectants and frequency of use of footbath

Items	Frequency	Percentage
(a) Reconstitution practice of farmers		
As directed by manufacturers	28	41.17
As desired by farmers	40	58.82
Total	68	100
(b) Frequency of disinfectant change		
Daily	8	11.76
Every other day	40	58.82
Weekly	20	29.41
Total	68	100
(c) Frequency of use of footbath		
Farmers that insists on use of footbath		
Farmers that do not insists on	30	44.11
Use of footbath	38	55.88
Total	68	100

Source: Filed data 2009.

Table 11 - General use of disinfectants in farming activities

Items	Frequency	Percentage
(a) Use of disinfectant in washing Feed/water trough		
Yes	26	38.23
No	42	61.26
Total	68	100
(b) Use of disinfectants in washing Farm clothes/footwear		
Yes	14	20.58
No	54	79.41
Total	68	100
(c) Use of disinfectant in cleaning		
Poultry house after each batch of bird was culled		
Yes	58	85.29
No	10	14.70
Total	68	100
(d) Use of disinfectant in washing After handling of birds		
Yes	20	29.41
No	48	70.58
Total	68	100

Source: Filed data 2009.

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While the relationship between antibacterial use, and emergence and spread of resistance may be complex (Piddock, 1996; DZC, 1997), the misuse of anti-bacterial in animal production, has been partly linked with the escalating rates of bacterial resistance in the study area and worldwide (WHO, 1997; Okoli, 2004).

Table 11 highlighted the other general uses of disinfectants in the study farms. The result showed that 58 (85.22%) of farms use disinfectants to wash the poultry pens after the birds have been culled, while less than 30% of farmers use disinfectant in washing farm equipment, cloths or themselves.

These findings indicate that majority of the farms in the study area are not practicing adequate biosecurity measures. Disinfection of poultry house and equipment has become an integral part of modern poultry management and these, is to help in reducing the microbial load to zero or near zero in and around the farm premises (Mrigen, 2006).

The result of the survey of poultry farmers indicates that out of the 90 farms sampled 68 (75.55%) use disinfectants. From the number of farms that use disinfectant only 50 (55.53%) have disinfectant footbath at the entrance of the buildings. However, only 30 (44.11%) had disinfectant always in the footbath.

This study shows that what determines the disinfectant farmers use is availability and not effectiveness. This explains why Izal® and Z-germicide® are most widely used by farmers. From table 4.8 Izal® tops the list of disinfectants used by farmers inspite of the fact that it is not recommend for use in poultry farming by the manufacturers. This survey also showed that 58% of farmers reconstitute the disinfectant as they desired and not as recommended by the manufacturers while 55% of farmers do not insist on the use of footbath in their farms.

CONCLUSION

The survey of animal health practice outfits in Imo State shows that the animal health practitioners stock, prescribe and sell mainly phenolic products. Topping the list of product from this chemical group, which they sell to poultry farms are Z-germicide® and Izal®. The poultry farmers in turn use mostly Izal® and Z-germicide® for disinfection in their farms. This is because they are readily available in all the outfits and are also cheaper than the other disinfectants. These, they use without consideration to their relative efficacy.

Most poultry farms in Imo State do not use disinfectant footbath. Those that use them do not insist on workers or visitors dipping their feet in them before entering the farm house. They also do not reconstitute the disinfectants according to the manufacturer's instructions. This makes the disinfection practice very inadequate when compared to the emphasis attached to biosecurity programs in poultry farming worldwide.

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