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Household Pests Infestation and Efficacy of Control Practices in Naka and Makurdi Benue State, Nigeria.

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Abstract

This study investigated household pest infestation and control practices in Naka (rural) and Makurdi (urban) areas of Benue State, Nigeria. A multistage sampling technique was used to select 200 households (100 from each area), and questionnaires were administered to investigate pest control methods and financial implications. Five pesticides; Commando (Zinc phosphide), No Mercy (Zinc phosphide and Brodifacoum), Nuvan (Dichdorovas, Parafin oil, fragrance, and K.O.S.S.), Rodenticide (Brodifacoum), and Green Leaf (Fipronil), were evaluated through field application and a follow up laboratory experiment further assessed these substances. Data were analyzed using Chi-square (χ^2), t-tests, means, and standard deviations. A total of 799 pests were recovered, with 405 (50.69%) from Naka and 394 (49.31%) from Makurdi, showing no significant difference between areas ($\chi^2 = 14.067$, df = 7, p = 0.476). Ants (Formicidae spp.) were the most predominant pests. Although residents ranked cockroaches (Periplaneta americana) highest in Makurdi (3.39 ± 0.76) and rodents (Rattus norvegicus) in Naka (3.49 ± 1.02). Chemical control was the most common used method (80%), followed by food poisoning (65%) and biological methods (28%). The average monthly expenditure on pest control was ₦3,075 in Naka and ₦3,133 in Makurdi. Laboratory tests showed no significant difference in mortality rates among pesticides against ants and cockroaches ($\chi^2 = 2.263$, df = 1, p = 0.201). However, Zinc phosphide was significantly more effective against rodents ($\chi^2 = 6.66$, df = 1, p = 0.032). A community-based pest management strategy is recommended for sustainable control in both areas.

Keywords: Households pest, Control practices, Residents perception

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Introduction

Pests attack almost all living things and the human population seems to be more exposed to their stings and bites because their breeding places are close to residential areas (Vazirianzadeh *et al.*, 2014). Due to the economic and medical importance of pests, many control methods have been employed in order to control their population and the use of pesticides, have become the easiest and most readily available method employed by households (Dehghani *et al.*, 2016).

In the United Kingdom (UK), it was reported that pests caused 89% of damage to household materials 77% to pipes and 63% to furniture (Osipitan *et al*., 2012). Household pests have been implicated as vectors to some diseases in Nigeria (Abba *et al*., 2020). Rodent's infestation has long been associated with risk of Lassa fever epidemics and the transmission of other diseases like; *Salmonella*, murine typhus, plague, rat bite fever, and leptospirosis (Bonner *et al*., 2007). Pest infestation has been directly related to poor sanitation and Poor housing conditions as well as overcrowding and co-habitation of humans with livestock such as poultry (Omudu & Akosu, 2013 and (Adelusi *et al*., 2022).

Studies in UK and United State of America (USA) have reported that over $3 billion is spent for pest control services alone and $400 billion for individual do-it-yourself and another $520 million to keep pets' pest-free (National Pest Control Association, 2013). Consequently, this study was designed to investigate household pest infestation, efficacy of control practices and household expenditure to control pests in Naka (Rural) and Makurdi (Urban) area of Benue State.

Materials and Methods

Description of Study Areas

The study was conducted in Naka Gwer-West and Makurdi Local Government Areas of Benue State, Nigeria. The inhabitants of the area are predominantly farmers of Tiv ethnic group. The settlement pattern of Makurdi is classified as compact or nucleated settlement, this is because the houses are constructed very close to each other, unlike Makurdi the settlement in Naka is linear settlement in such settlement houses are established along a road (Obiora *et al.*, 2015, Nwosu and Akor, 2018) . Makurdi is geographically located between latitudes 6025' and 808'N, and longitudes 7047' and 1000' (NPC, 2009) while Naka geographical coordinates are latitudes 7º35'0.24'' and longitudes 8º12'19.8'' (Figure 1) (Geodatos, 2024). These areas accommodate some factors responsible for pest infestation, these factors include indiscriminate waste disposal, poor sanitation, and overflowing trash cans which attracts wide range of pests. Also, various items like luggage, furniture, and even clothing inadvertently introduce pests through immigrants. Small cracks, gaps, and openings on walls, doors, windows and roofs act as entry points for pests (Rauh *et al.*, 2012).

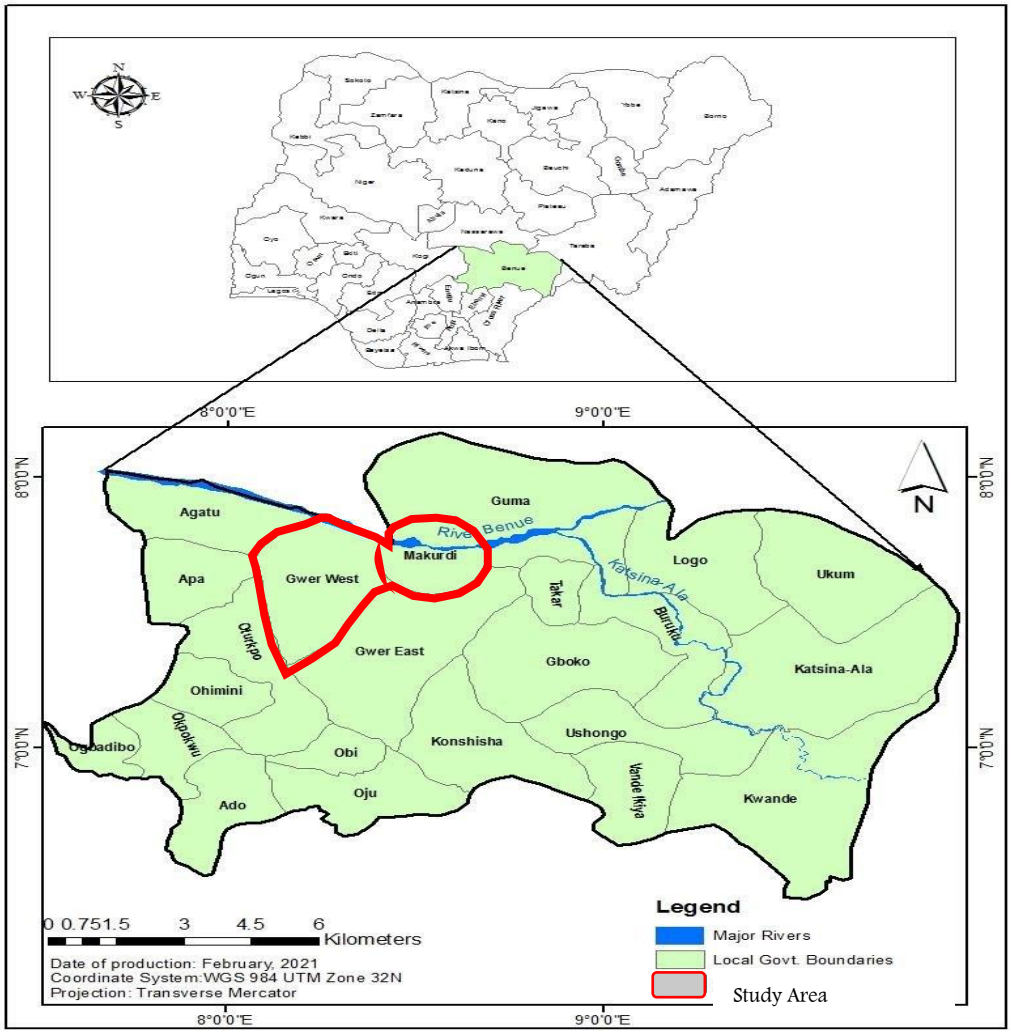

Figure 1: Map of Benue State Showing Gwer West and Makurdi Local Government Area

Sample and Sampling Technique

A total of two hundred (200) households were sampled and 5 brands of chemical pesticides were used. The samples were arrived by multistage sampling technique. First, stratified random sampling was used to select two points in each of the study areas; Kpankeghkegh and High-level in Naka while in Makurdi, Wadata and Kanshio were selected to ensure that different segments in the population are equally represented and a systematic random sampling to survey every 2nd house on a named street. Each of the study areas were further subdivided into two points A and B for easy sampling.

Data Collection

Pest house invasion questionnaire (PHIQ) was adopted from (Laurel, 2015) and modified to suite this study, while mortality rate observation rating scale (MRORS) was adopted from WHO, (2012) on guideline for testing the efficacy of insecticide

products used in aircraft. Two hundred (200) structured questionnaires were administered to respondents. This includes; demographic data, control practices employed, financial implication of pest control as well as knowledge, attitude, and perception of pest infestation in households. The perceived infestation rate from respondents was ranked as highly infested (HI), infested (I), moderately infested (MI), and not infested (NI).

Application of pesticides to control household pest

Samples of commercial pesticides were bought and distributed to 100 households; 50 from each local government. The pesticides were "Green leaf" (*Fipronil*), "No-mercy" (*Zinc phosphide and Brodifacoum*), "Rodenticide" (*Brodifacoum*), "commando" (*Zinc phosphide*) and10ml of "Nuvan" (*Dichdorovas, Parafin oil, fragrance and K.O.S.S*) were given to members of the selected households for application. Dead Pests were retrieved from the houses after 24 hours period for 5 days. Specimens were collected in well labeled containers and brought to Postgraduate research laboratory, Benue State University for counting and identification.

Laboratory trail of commercial pesticides

A laboratory experiment was designed to test efficacy of commercial household pesticides. The experiment involved application of the selected commercial pesticides to some of the pest in vivo and the design was a one-shot case experimental design where the independent variable was used to manipulate the dependent variable. A total of 15 rodents were trapped and caged in three different cages, using simple random sampling to select 5 for each cage, 20 ants and cockroaches were also selected and caged differently. Data on mortality rate was recorded every 30 minutes for 48 hours after exposure.

Data Analysis

The data were analyzed by using descriptive statistics, t-test analysis and chi-square test to determine the degree of efficacy of the pesticides against the pests

RESULTS

A total of seven hundred and ninety-nine (799) pests were collected from one hundred households, 50.68% (405) were collected in Makurdi while 49.31% (394) were collected in Naka (Table 1). There was no significance difference in pest infestation in relation to locations (p=0.476). Kpankeghkegh 235(58.03%) had a higher pest infestation than High-level 170(41.98%) in Naka while Wadata 230(58.38%) had a higher infestation than Kanshio 164(41.62%) in Makurdi. Among pests recovered, after applications of insecticide, Ants (*Formicidae*) (52.82%) were the most predominant followed by cockroaches (*Periplaneta americana*) (22.15%), rodents (*Rattus norvegicus)* (13.02%), house cricket *(Acheta domesticus)* (7.76%), spiders *(Parasteatoda tepidariorum)* (3.63%), beetle (*Amara nigrium*) (0.38%), millipedes (*Eurymerodesmus spp*) (0.13%), and scorpions (*Scorpio maurus*) (0.13%) respectively.

The perception of respondents on infestation of pests in relation to harborages varied greatly at different locations (Table 2). The residents ranked

Cockroaches as more predominant in Makurdi (3.390±0.76), than Naka (3.0100±1.15), while Rodents were ranked more predominant in Naka (3.490±1.02) than Makurdi (3.170±0.93). This difference was statistically significant, while all other pests showed no statistically significant difference (Table 3).

The use of chemicals 160(80%) was the highest method of pest control employed by residents, followed by food poisoning 131(65%), trapping 85(42.5%) and biological method (use of cats) 56(28%) respectively (Fig. 2). Household's pest control expenditure indicate that residents spend an average of ₦3,075 (Naka) and ₦3,133 (Makurdi), monthly on pest control. This amount to ₦36,882 (Naka) and ₦37,596 (Makurdi), annually on pest control expenditure. There was a slight difference between the expenditure on household pests control monthly and annually in urban (Makurdi) and rural (Naka) areas respectively (Table 4 and 5).

Effectiveness of pesticides sold to the public for pest control and assessed based on mortality rate. Out of five (5) rats exposed to each chemical substance, 4 rats died from Zinc phosphide, 2 rats died from Brodifacoum and none died from *Zinc phosphide and Brodifacoum* within 42 hours. *Zinc phosphide* was more effective on rodents. Meanwhile, 20 insects (ants and cockroaches) were also exposed to different chemical substances and the following mortality rate was observed in 24 hours, "No mercy" 8 ants, 9 cockroaches, "Nuvan" 16 ants, 15 cockroaches and green leaf 15 ants, 17 cockroaches, died from the treatments respectively. There was no significant difference in treatments used for insect control ($p>0.05$) Fig.3, 4 and 5.

Table 1: Occurrence of Household Pest in Naka and Makurdi Local Government Area of Benue State

Locations	**No of Household**	**No of household with dead pest**	**Number of pests collected**								**Total**
			Cockroaches (*Periplaneta americana*)	**Ants** (*Formicidae*)	**Rodents** (*Rattus norvegicus*)	**House cricket** *(Acheta domesticus*	**Spider** *(Parasteatoda tepidariorum*	**Beetle** (*Amara nigrium*	**Scorpion** (*Eurymero-desmus spp)*	**Millipede** (*Scorpio maurus*)	
Naka											
High-level	50	39(78%)	41	60	35	32	0	01	01	0	170(41.98%)
Kpankeghkegh	50	38(76%)	35	136	33	24	6	0	0	01	235(58.03%)
Makurdi											
Wadata	50	43(86%)	71	126	20	01	12	0	0	0	230(58.38%)
Kanshio	50	33(66%)	30	100	16	05	11	02	0	0	164(41.62%)
Total	**200**	**153**	**177(22.13)**	**422(52.82)**	**104(13.02)**	**62(7.76)**	**29(3.63)**	**03(0.38)**	**01(0.13)**	**01(0.13)**	**799**

(df=7,$\chi^2_{cal} = 0.713$,,$\chi^2_{tab} = 14.067$),P=0.476.

Table **2: Residents perception of pest infestation harborages in Makurdi and Naka**

S/N	Ranking	Harborages					
		Inner room	Open space	Boxes and hiding corner	Food store	Toilet	Dropping in every places
1	HI	38.5	27.5	16	13.5	15.5	7.5
2	I	40.5	57	62.5	60.5	48.5	40
3	MI	13	8	11	19	28.5	41
4	NI	8	7.5	10.5	7	7.5	11.5

Key: HI= highly infested, I= infested, M= moderately infested, NI= not infested

Table 3: Resident perception on distribution of household pests in Makurdi and Naka

S/N	Pest	Locations					
		Makurdi Mean SD	Naka Mean SD	T	df	p-value	Remarks
1	Cockroaches	3.39±0.76	3.01±1.15	2.752	198	0.006	Significant
2	Ant	2.98±1.04	2.82±1.06	1.07	198	0.283	Not significant
3	Bedbugs	1.11±0.49	1.12±0.43	-153	198	0.879	Not significant
4	Rodents	3.17±0.93	3.49±1.02	-2.315	198	0.022	Significant
5	Wall geckos	1.58±0.61	1.52±0.52	0.750	198	0.454	Not significant

Note: Values are mean SD± in duplicate

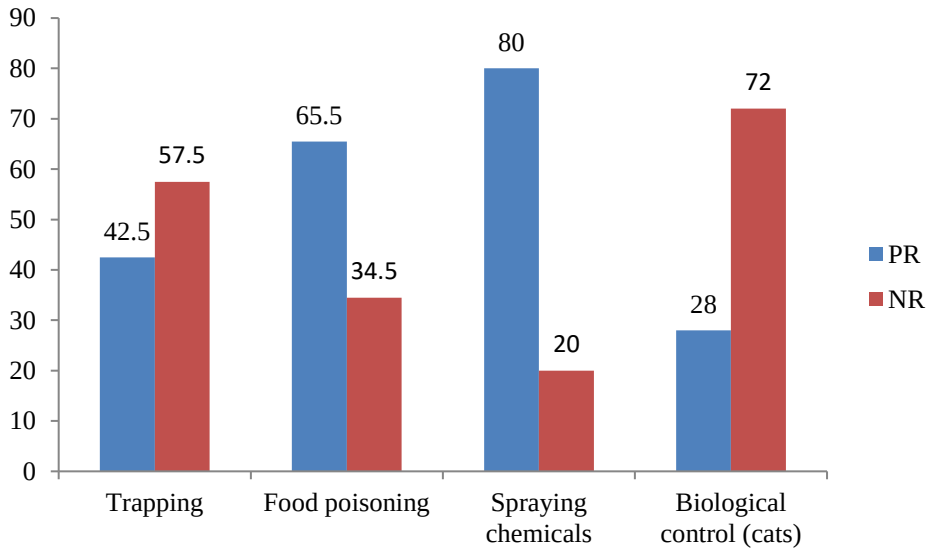

Figure 2: Pest Control Practices among Residents in Study Area
Note: PR= positive result, NR= negative result.

Table 4. Monthly Expenditure on Control/Method of Household Pests in Naka

S/N	Mode of control	Expenditure					
		₦250	₦800	₦1550	₦2000	Monthly	Yearly
1	Trapping	37	56	06	1	₦ 63,550 (**₦635.5**)	₦762,600(₦7,626)
2	Food poisoning	22	52	26	0	₦ 87,400 (₦874)	₦1m (₦10,488)
3	Spraying chemicals	27	09	52	12	₦118,550 (₦11,86.5)	₦ 1.4m (₦14,226)
4	Biological control (cats)	78	21	1	0	₦ 37,850 (₦378.5)	₦454,200(₦4,542)
	Total	**164**	**138**	**85**	**13**	**₦648,000 (₦ 3,075)**	**₦ 3.7m (₦36,882)**

Note: The figures in parentheses are in average

Table 5. Monthly Expenditure on Control/Method of Household Pests in Makurdi

S/N	Mode of control	Expenditure					
		₦250	₦800	₦1550	₦2000	Monthly	Yearly
1	Trapping	33	45	05	17	₦ 55,400 (**₦554**)	₦664,800 (₦6,648)
2	Food poisoning	23	50	21	6	₦ 90,300 (**₦903**)	₦ 1.1m (₦10,836)
3	praying chemicals	23	19	40	18	₦117,800 (**₦1,178**)	₦1.4m (₦14,136)
4	Biological control (cats)	59	38	03	0	₦49,800 (**₦498**)	₦597,600(₦5,976)
	Total	**138**	**152**	**69**	**41**	**₦313,300 (₦3,133)**	**₦3.8m (₦ 37,596)**

Note: The figures in parentheses are in average

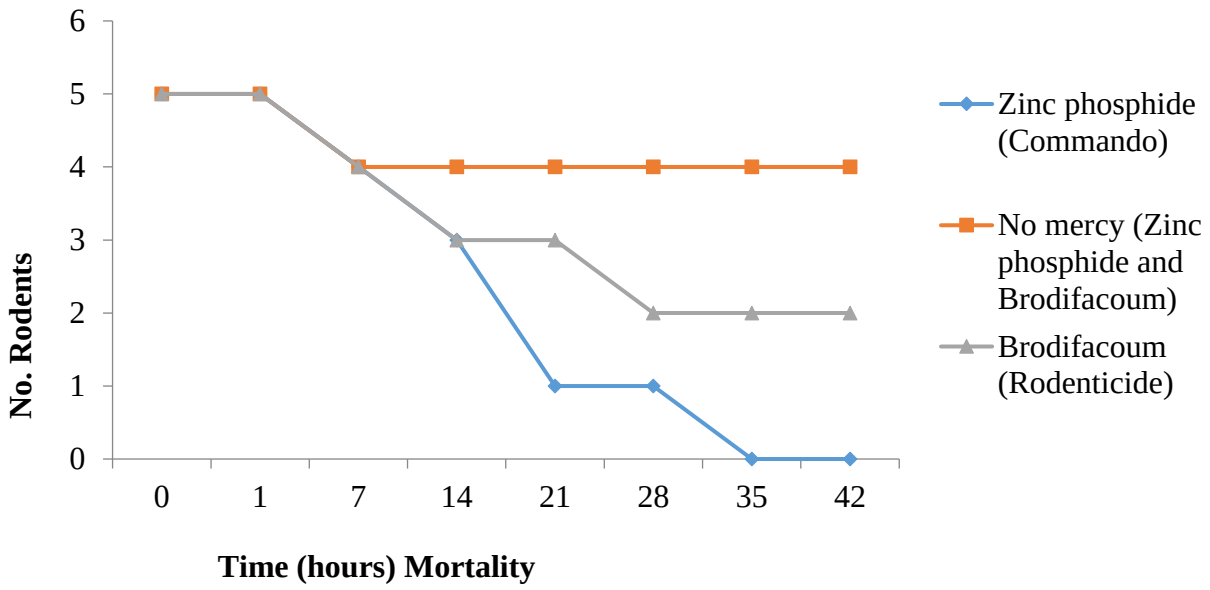

Figure 3: Laboratory Trial of Rodent's Mortality Using Different Market Substances

(df= 1, $\chi^2_{cal} = 6.66$, $\chi^2_{tab} = 3.841$) p=0.032

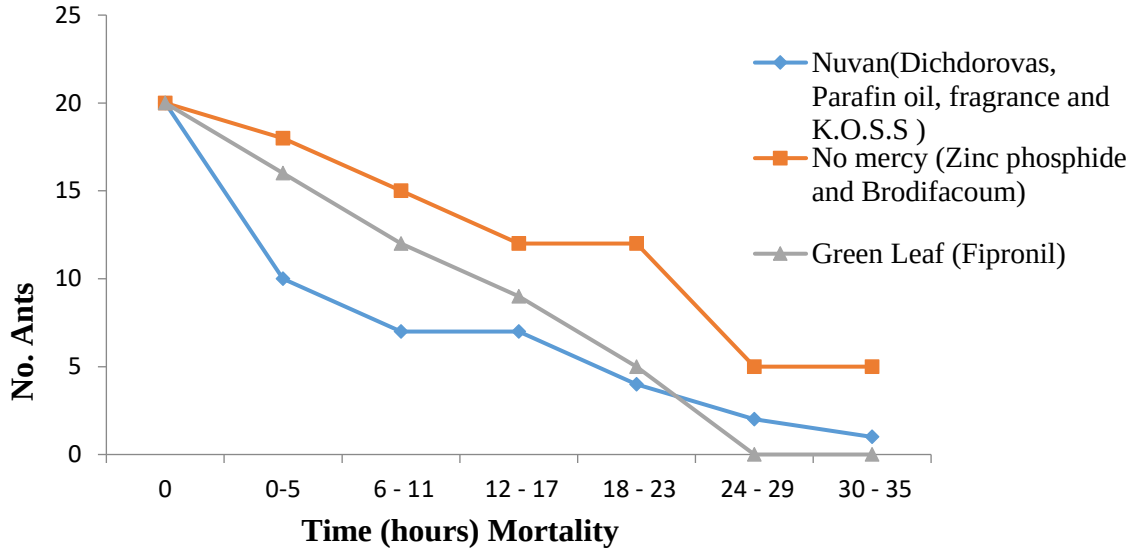

Figure 4: Laboratory Trial of Ant's Mortality Using Different Market Substances
(df= 1, $\chi^2_{cal} = 2.263$, $\chi^2_{tab} = 3.841$) p=0.201

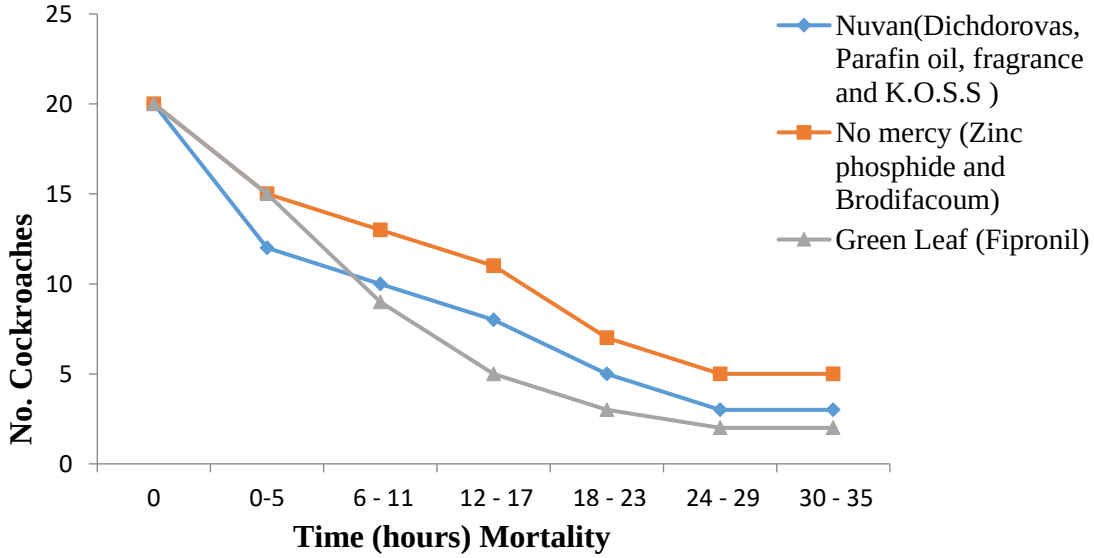

Figure 4: Laboratory Trial of Cockroaches Mortality Using Different Market Substances (df= 1, $\chi^2_{cal} = 2.263$, $\chi^2_{tab} = 3.841$) p=0.201

Discussion

Pest infestation rates were higher in Naka than Makurdi. The infestation rate in this study however is lower than the rate reported in South Eastern Nigeria (Orji, *et al*., 2020). High rats' infestation rates observed in Naka corroborates with studies in Esan, Edo state (Tobin *et al*., 2014) and Osogbo, Osun state (Olalekan, 2015).These may be the reason for the significantly high rat infestation rates in rural areas, indiscriminate disposal of refuse and poor sanitation, Inappropriate storage of food, small cracks, gaps, and openings on walls, doors,

windows and roofs act as entry points for pests (Chaiyasit *et al*., 2020).

Household pest infestation have epidemiological implications, some of the pest encountered in this study have been incriminated as vectors of human diseases (Omudu and Akosu, 2013; Adelusi *et al.* 2022). Indirect health consequences of household pest infestation are the resultant increase in use of pesticides. Frequent pesticide uses results in high indoor residual pollution and poor air quality within rooms (Omudu and Akosu, 2013).

According to Omudu (2008) an increasing poor hygiene has been one of the several factors responsible for high infestation of bedbugs in two Nigerian cities Makurdi and Otukpo, which might also be the reason for resurgence of bedbugs in this study, some respondents were of the opinion that the resurgence of bedbugs is as the result of influx of individuals from infested areas.

The cost of pest management in these resource poor localities could be causing serious financial strain on family budget, this corroborate with a study in Benin Republic that reported economic losses due to rodent's infestation to be almost €16000 in 25 days and a simple extrapolation leads to €58,400 per year (Henri-Joel *et al*., 2020). Several other researchers have also reported the financial cost of control of household pests for instance, National Pest Management Association (NPMA) (2017) estimated that termites and other insect pest cause more than $5 billion in property damage each year in America.

The effectiveness of substances varied in effects on the control of household pests. The difference in effectiveness may be as a result of the different concentration of primary compounds in the chemicals as well as and method of application. The outcome of this study justifies the need for greater community participation in pest control and the need to regulate the use of chemicals to control pest indoors.

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