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Full Length Research Paper

The effect of preparation methods on fenthion residues in sprayed quelea birds for human consumption

Didas J. Moshi[1], Thadeo M. C. Tarimo[1], Patrick A. Ndakidemi[1] and Linus Munishi[1]

Department of Sustainable Agriculture, Biodiversity and Ecosystem Management School of Life science and Bio-engineering, Nelson Mandela Institution of Science and Technology, P.O. Box 447 Arusha, Tanzania[1]
Corresponding Author's E-mail: moshid@nm-aist.ac.tz

Abstract

The aim of this study was to assess the different local methods that are used by the communities to prepare quelea birds collected after spray with Queleatox for human consumption. It was conducted in order to compare their effects in reduction of fenthion residues. The assessment of various local preparation techniques was done through social survey where by a questionnaire was administered to enumerate 34 respondents and data was collected. This study was conducted at Ikonda village in Shinyanga region with coordinates 03° 54'.097''S and 27°.033'. 035'E' and at Basotu village in Arusha regions with 04° 31'.658''S and 036° 12'.921''E coordinates. Both areas are famous for the production of three common cereal crops of rice, wheat and barley in Tanzania where by aerial spray of Queleatox to control quelea birds are done as an annual event. This social survey was conducted two days before spray operations in both sites after which samples of sprayed birds were randomly collected for fenthion residues analysis in laboratory. Residues analysis was done in Tropical Pesticides Research Laboratory (TPRI) by using Gas Chromatography with Mass Spectrometry (GC-MS). Results from general social survey showed that the mostly used preparation methods are frying in oil, boiling and grilling after washing. Results from fenthion residues analysis showed washing and cooking had significant effects in reduction of residues to below detection limit by GC-MS compared to raw sprayed samples which demonstrated some residues content.

Keywords: Fenthion residues, sprayed Quelea birds, Preparation methods, GC-MS.

LIST OF ABBREVIATIONS USED

SBO = Sprayed boiled samples
SCOL = Sprayed cooked in oil(frying)
SR = Sprayed raw (untreated samples)
CO = Control (unsprayed samples)
PSA = Primary Secondary amines
PTEE = Polytetraflouoethylene
DLCO-EA= Desert Locusts Control Organization for Eastern Africa.
GLC = Gas Liquid Chromatography

INTRODUCTION

Spraying with the organophosphate fenthion has been the common means to control the red-billed quelea *Queleaquelea*, a major bird pest of medium and small cereals throughout semi-arid regions of sub-Saharan Africa, for more than seventy years (Mc Williams, 2004). Although application of the fenthion in the control of Quelea birds has shown significant effects in saving crops that would have been lost through destruction by these granivorous birds, their use has raised serious concern (CABI, 2014). Besides high cost of fenthion, its

direct effects to non target species, secondary poisoning to consumers of sprayed birds and environmental contamination are some of reasons of this concern. Residues of fenthion components are bio accumulative and toxic for human (Perdardar, 2015). Presence of high level of residues of pesticides can have detrimental effects on public health and in the recent years there has been increasing concerns about this issue (Perdardar 2015). However, washing of pesticides contaminated food materials with water or soaking in solvent solutions are reported to be highly effective in reducing the level of pesticides residues (Abdalla et al. 2013). Preliminary preparatory steps like plucking, evisceration and trimming out of featherless parts can remove the chemical residues from outer portions. Various thermal processing treatments like grilling, boiling, frying in oil, steaming, have been found valuable in degradation of various pesticides depending upon the type of pesticide and length of treatment (Bajwa, 2011). The elimination of pesticide residues from the boiled food could be due to decomposition by the effect of heat, the stronger adsorption of pesticide onto meat tissues and/or the poor solubility of pesticides in water (Abou, 2001). For instance, after cooking of rice and beans which was contaminated by Organophosphates like chlorpyrifos and dichlorvos, and pyrethroids like decamethrin, cypermethrin in a commercial microwave oven; was evaluated by Castro *et al.* (2002); the results showed that 92% to 99% of the pesticides were eliminated. All stated examples can shade light and deserve investigation in sprayed birds used as source of food. The quelea birds treated with fenthion may invariably contain unpredictable amount of chemical residues, therefore, it becomes imperative to find out whether various preparation methods have significant effects in reduction or completely eliminate fenthion residues. The objective of this study was therefore to investigate the common preparation methods used by communities and their effects in the magnitude of pesticide residues in the sprayed quelea birds for human consumption in comparison to uncooked one in Tanzania.

MATERIALS AND METHODS

Study area

This study was conducted in two areas one at Ikonda village in Shinyanga district of Shinyanga region in Lake Victoria zone located at 03° 54'.097"S and 27°.033'. 035"E. The second study area was Basuto village in Hanang' district of Manyara region in Northern Tanzania located at 04° 31'.658" S and 036° 12'.921" E. Both areas are potential for production of three cereal crops of barley, rice and wheat and Sunflower in Tanzania whereby spraying with Queleatox is an annual event.

Social survey

This was done through administration of questionnaires. Enumeration was done by two Agricultural officers and involved 34 respondents of the age from 18 years in two sites. The major objective of this survey was to investigate methods used by the local communities to prepare sprayed birds for human consumption and the storage methods of the collected birds and awareness on health effects. Household approach was applied where by respondents were pre informed about the survey by the village leaders two days before and they were visited at home for enumeration. At Ikonda village the survey was done for two days from15th to 16th May 2015 while at Basotu it was done on 19th. There were 18 questions including social economic information but the most important ones were composed directly to give answers related to the objectives.

Data analysis

Total of 34 respondents were enumerated. The collected questionnaire data were analyzed using Statistical Package for Social Sciences (SPSS) Version 9.1. Descriptive statistics analysis of means and frequencies was used to summarize the farmers' preparation practices and storage for future use. This was conducted at 1 % and 5 % probability levels. One of the important questions in this questionnaire was to find out whether people in the selected area have the tendency of eating sprayed quelea birds.

The spray areas

The roost sites which were sprayed at Ikonda village in Shinyanga district and in Basotu village in Arusha was surveyed and identified two days before spraying. These sites were demarcated by flagging with white clothing materials in both four corners as the roost located area which can be easily seen by the spraying pilot from the sky. The roosting area in Ikonda was estimated to cover 1km long and 0.5km width, which is equivalent to 50 hectares spray area which was estimated to contain 1.5million bird population. The second spray site had three roosting areas of which the smallest one with an average area of 10 hacters was selected for sample collection. The dose rate calibrated by the DLCO-EA aircraft micro air sprayers was 2 litres of Fenthion per hectare which was applicable to both sites. For this case, 110 liters of chemical were discharged from the micron air rotary atomizers which are proven and best known for their uniform droplet spectrum unobtainable by conventional high pressure nozzles. The spraying operation was conducted in Shinyanga on the late

evening from 18:30 up to 19:20 hours on 17th May 2015 and in Basuto at the same time on 22nd May 2015.

Samples collection

Samples of dead birds were randomly collected in the following morning from 12 small plots of $2m^2$ demarcated along two imaginary diagonal lines from both four angles of the spray site intercrossing at the centre of the spray area. During this time both ground support and spray crews were also in the field for assessment of the killing percent through birds counting from the same small portions of $2m^2$ established in two diagonal lines of the spray area. Sixty samples of 3birds each were collected from both diagonal lines, making total of 180 birds collected from this area. This amount was to fulfill the requirement by the TPRI lab specification to produce two batches of samples and replicates of the same amount.

Field Samples Preparation

Samples collected from both spray sites were prepared through wet and dry preparation methods, as is the most commonly practiced by the communities during preparation of collected birds for consumption. In wet preparation method birds were soaked in warm water plucked, eviscerated and washed before cooked by boiling. In dry method, collected birds were plucked, eviscerated and fried in oil at home or grilled by flames in the field without soaking in to warm water. This was proved to be very easy plucking process than wet process, only feathers from the tail and wing parts were hard to remove. Birds prepared in this way are commonly fried in oil at home or grilled mostly by men in the field. Two batches of 10 samples were cooked in each recipe. Bird samples were prepared with replicates and rolled in to aluminum foil paper, packed in to special sample collection polythene bags and kept in the deep freezer overnight before transported in the cool boxes with ice parks also frozen overnight and submitted to Tropical Pesticides Research Institute Laboratory for residue analysis by GC-MS machine.

Fenthion residues analysis

The short summary of the method

Residues were extracted from sprayed bird meat samples with acetonitrile and distilled water was separated by addition of dichloromethane. The remained organic solvents were dried and evaporated by the rotor evaporator and residues were dissolved in acetone and then aqueous potassiun permanganet solution was added as the oxidizing agent. This resulted in to simultaneous removal of most of the interfering meat constituents. This followed by evaporation to remove the dichloromethane then residues were dissolved in acetone and analyzed using gas chromatography with mass spectrometry and spike calibration curve machine to examine the presence of fenthion residue in sprayed and processed bird samples from two cooking recipes (boiling and frying in oil) for human consumption and to estimate the residues reduction percentage by the cooking process.

Experimental Design

Analytical Equipment -GC-MS

GC-MS system (Agilent Technologies, USA) consisted of a 7890A Gas Chromatography equipped with a 7683 B series auto sampler and coupled to a 5975C Mass Spectrometer was used in samples analysis and quantification. Helium (purity 99.9995%) from Air Products Middle East FZE, Dubai – United Arab Emirates, was used as carrier gas. GC-MS Column used (DURABOND – 5MS, Agilent Technologies, USA) was 30m long, a width of 0.25 mm and internal diameter 0.25 µm and was set at an inlet temperature of 230 °C. Split less injection was selected and sample injection volume was 1 µL. Column oven ramp temperature was set at 50 °C at 5 °C /min, to 280°C held for 20 min.

Apparatus and consumables

A 4 digit decimal place analytical balance, GR-202-EC model, manufactured by A&D Instruments Ltd, Japan was used in sample weighing, nitrogen generator, vortex and sonicator machine were used in sample preparation. Heldolph rotary evaporator, Heizbad HCI-VAP model, manufactured by Heldolph Instruments GmbH & Co. Kg, German was used in concentrating sample extracts to about 2ml final volume. Automatic pipettes, suitable for handling volumes of 4 µL to 500 µL and 1 mL to 5 m,50 ml PTFE centrifuge tubes with screw caps , 15 ml PTFE centrifuge tubes with screw caps, Automatic axial extractor, Centrifuge, suitable for the centrifuge tubes employed in the procedure and capable to achieve at least 3700 rpm , Concentration workstation, Syringes, e.g. 2 mL disposable syringes, Syringe filters, 0.45 µm pore size, Injection vials, 2 ml, suitable for LC and GC auto-sampler, Volumetric flasks, Z-Sep® sorbent (Supelco).

Reagents and Chemicals

Pesticides standard for fenthion analysis (Sigma Aldrich 2015) were used. Reagents of high grade Acetonitrile ultra gradient grade, Acetone, Petrolleum spirit, dichloromethane, Cyclohexane and ethyl acetate were obtained from scan Tanzania ltd a local representative of SIGMA ALDRICH, of USA the agent for sulpply of solvents and reagents in Tanzania. Sodium chloride,

Magnessium sulphate, Sodium acetate, Pottassium permanganate, Acetic acid, Formic acid, Trisodium citrate dihydrate, Saturated sodium chloride, Disodium hydrogencitrate sesquihydrate, Anhydrous magnesium sulphate and Ultra pure water was also used.

Recovery experiments for validation of Analytical method

In chemical analytical procedures, the validation of analytical methods is used to demonstrate that the method is set for its purpose; it must follow a plan which includes scope, performance characteristics, and acceptable limits. For this case, the samples employed in this validation studies did not contain any added fenthion. Stock solutions (100 mg/L) were prepared in acetonitrile and ethyl acetate and were stored in amber screw capped glass vials in the dark at -20 °C (Zipper, 2014). Samples were fortified using known concentrations of Fenthion, oxidixed and analysed for recovery test. A recovery of above 80 percent was obtained.

Lab Sample preparation

Sample preparation technique used in this study was Matrix solid phase dispersion where by extraction and isolation of fenthion residues from sprayed birds involved the use of water miscible solvents like acetonitrile and methanol followed by liquid-liquid partitioning with organic solvents like cyclohexene and saturated acetonitrile (Sara et al. 2010). A representative samples (approximately 20g) was finely grounded with meat mincer and mixed with anhydrous sodium hydroxide to make a free flowing powder in mortar and pestle and transferred into a 15 ml centrifuge tube. After the sample was homogenized, 15.0 g was accurately weighed, ready for extraction for fenithion residue analysis which was performed by the following steps: i) Blending 15 g of sample in 50 mL PTFE centrifuge tube. ii) 100 µL of surrogate standard was added iii), Vortexing for 3 minutes v) then 6 g of magnesium sulphate, 1 g of sodium chloride, 1 g of trisodium citrate dehydrate and 0.5 g of disodium hydrogen citrate sesquihydrate were added. vi) Vortexing for 4 minutes. vii) Centrifuged for 5 min at 3700 rpm. viii) Then 5 ml of supernatant was transferred into 15 ml PTFE centrifuge tube containing 175 mg of Z-Sep and 750 mg of MgSO4 and shacked in a vortex for 30 s. ix) Then Centrifuged for 5 min at 3700 rpm. x) This aliquot was evaporated under gentle stream of nitrogen. xi) The sample was filtered through 0.45 µm PTFE filter and sent for GC analysis.

Sample Extraction

Matrix solid phase dispersion (MSPD) approach was used for fenthion extraction in this study (Baker, 2007). Extraction was performed in the centrifuge tube using 50ml of Petroleum spirit Acetone (1:1). 50 ml of saturated Sodium Chloride was added and vortex vigorously. Then centrifuged at 4000 rpm, after which the supernatant liquid were taken. This extraction was repeated with another portion of Petroleum spirit: Acetone (1:1) vortex then supernatant liquid were taken and combined the two extracts. Then the extract was evaporated to dryness using a rotor evaporator. Residues were extracted from sprayed bird meat samples with acetonitrile and distilled water was separated by addition of dichloromethane. The remained organic solvents were dried and evaporated by the rotor evaporator and residues were dissolved in acetone and then aqueous potassiun permanganete solution was added as the oxidizing agent. This resulted in to simultaneous removal of most of the interfering meat constituents. This was followed by evaporation to remove the dichloromethane then residues were dissolved in acetone and analyzed using gas chromatography with mass spectrometry and spike calibration curve machine to examine the presence of fenthion residue in sprayed and processed bird samples from two cooking recipes (boiling and frying in oil) for human consumption and to estimate the residues reduction percentage by the cooking process.

Sample Clean up

Sample partition was done by dissolving the residues in 10 ml of 1% acetic acid in acetonitrile in a 50 ml centrifuge tube; and 10 ml de-ionized water was added. Six (6) g magnesium sulphate and 1.5 g of sodium acetate was added, and vortex shortly and centrifuged at 400 rpm. The supernatant solution were taken and evaporated to dryness. Collected residue were dissolved using 3 portion of 1 ml cychlohexane and transferred to a separating funnel, then 20 ml cychlohexene and 60 ml of saturated sodium chloride were added and shaked vigorously after which the supernatant liquid was taken. Re-extraction with 50ml petroleum ether was done, concentrated the combined extract and evaporated to dryness using rotor evaporator. This extract was transferred to a 15 ml centrifuge tube using three (3) portions of 1 ml cyclohexane. Six (6) ml of acetonitrile were added and vortex, centrifuged for five (5) minutes and the top layer acetonitrile was collected, repeated extraction by another six (6) ml portion of acetonitrile, vortex and centrifuged. The upper layer of acetonitlile was taken and combined the extract, Evaporated to 2ml and cooled to – 80 ^{o} C, using liquid nitrogen cooler for 1 hour. In the final removal of fats, this extract was centrifuged when cold and the clear liquid were taken. This cooling and centrifugation were repeated 4 times before adding dichlormethane to remove water. Then evaporated to dryness and 5ml of acetone added. The aliquot was evaporated under gentle stream of nitrogen and the sample was filtered through 0.45 µm PTFE filter and sent for GC analysis. Analysis was performed by

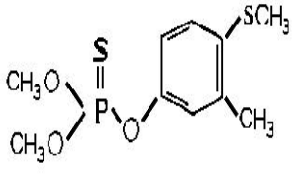
GC-MS with the Subscriber Identity Module (SIM) mode based on the use of one target and two qualifier ions. Pesticides were identified according to their retention times, target and qualifier ions. The quantification was based on the peak area ratio of the targets to that of internal standard.

Oxidation

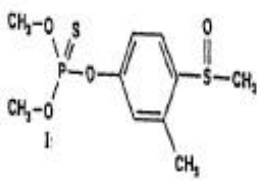
In this study, oxidation was initiated for the determination of residues of fenthion and its oxidative metabolites in fenthion sprayed bird meat after meat from treated samples demonstrated very low level of fenthion residues below detection limit. Meat samples were fortified with fenthion followed by extraction process. According to Lentza-Rizos et al, (1990), oxidation was also made during determination of fenthion residues and its metabolites in Olive oil whereby recovery by GC-MC was 88%. After extraction, the residues were oxidized with potassium permanganate solution to fenthion sulphone and fenthion sulphoxide and determined by gas-chromatography. After oxidation the fenthion derivatives become more stable. For this case, fenthion oxidation with 2.5 ml of 0.5 N of Potassium permanganate was done and samples left to react under normal sunlight at 280 nm to 300nm for 5 minutes at room temperature. Then evaporated to dryness by rotor vaccum evaporator and 3 ml acetonitrile was added, transferred to a centrifuge tube with 300 mg magnesium sulphate, 150 mg PSA, 150 mg activated Charcoal, then vortex, centrifuged and analyzed using GC MS. Potassium permanganate was chosen as the oxidant because it is less hazardous than peroxides and was found to give consistent yields of sulphone. Further, it leaves the P=S group intact, thus facilitating residue determination because oxons are generally less stable than the parent compounds and their GLC determination is considerably less reliable. Oxidation with permanganate has been widely used for the determination of pesticides and their metabolites in food items, fruit and vegetables. GC-MS analyses of sulfoxides were difficult for the following reasons: First Sulfoxide is easily produced from sulfide by oxidation, and tends to change into sulfone by additional oxidation. And secondly it has a higher polarity than sulfide or sulfone because of its strong polarization between sulfur and oxygen

Chemical structures

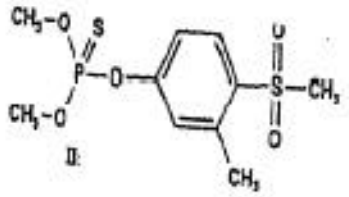
(A-1) fenthion,



A-2) fenthion sulfoxide,



(A-3) fenthion sulfone,



Due to co-elution with some fatty acids, fenthion was oxidized in order to elute at a time where there were no co-eluted fatty acid compounds in order to confirm its presence as shown in the reaction and chromatogram figure 8.

RESULTS AND DISCUSSION

Results from Social survey for preparation methods

Results showed that majority of respondents (56%) accepted that most of sprayed quelea birds in Ikonda are taken by human as source of protein, 30% feeding pet animals and 14% are left in the spray site (Figure 1).

Plucking

The findings showed that there are two major plucking methods that are practiced by communities who eat sprayed birds notably the dry and wet methods. In wet method, the collected birds are soaked in warm water for removal of feathers. The dry method involves plucking, eviscerating and frying in oil or grilled in flames of the collected sprayed birds without soaking in warm water.(Figure. 3.)

Three preparatory (cooking) methods were revealed in this survey as commonly practiced by communities mostly women by 58%, that eat sprayed birds as frying in oil (45%), boiling (33%) and grilling in flames (22%) (Fig.3). Majority of the respondents indicated that frying in oil is the most preferred method as it produces delicious product especially immediately after collection, but after drying boiling became most popular than frying. Grilling of birds by flames of fire is mostly done by men in the field while other methods are carried out at home mainly by women. (Figure 4)

Preservation method

After initial processes of plucking, removal of head and evisceration, bird carcasses are prepared for immediate use while others are stored for future use. Respondents indicated that storage can take up to three months. However, (Tarimo, 1987 unpublished) reported that

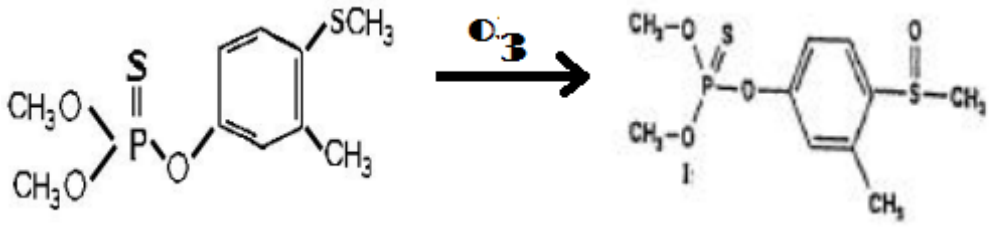


Figure 1. Fenthion metabolites after oxidation with Pottasium Permanganate.

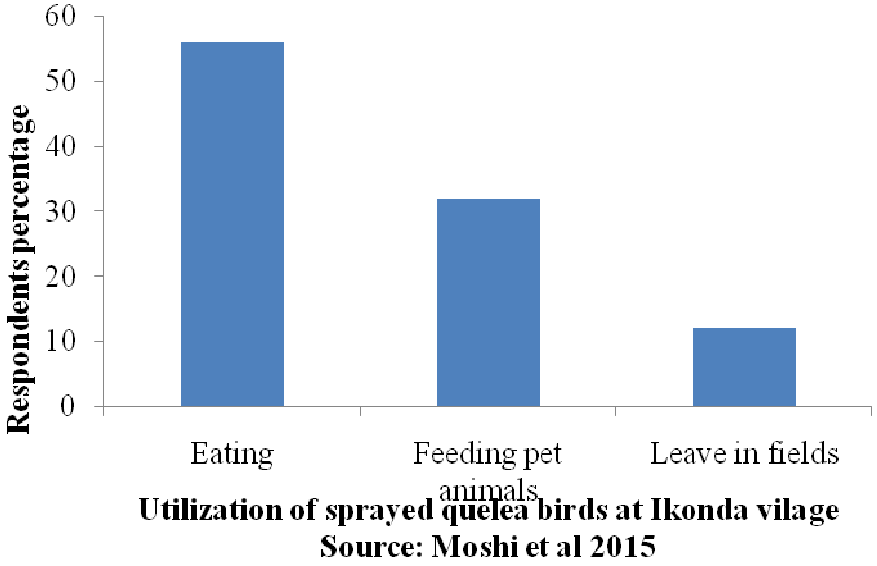


Figure 2. Utilization of sprayed quelea birds taken as source of protein at Ikonda village in Shinyanga, Lake Zone of Tanzania

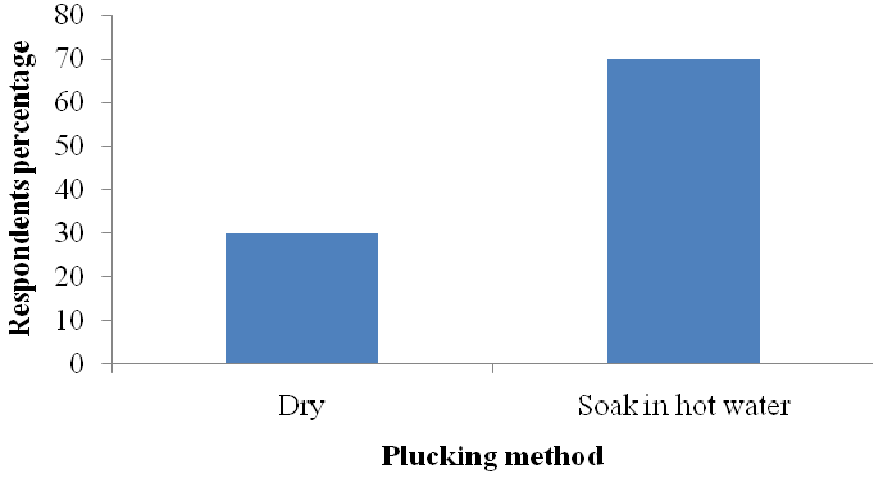


Figure 3. Showing plucking methods

Sukuma people in Ngudu, Kwimba normally stores prepared birds up to the next quelea control season which is 9 up to 12 months. Results showed that 67% of the respondents preserve birds through sun drying while

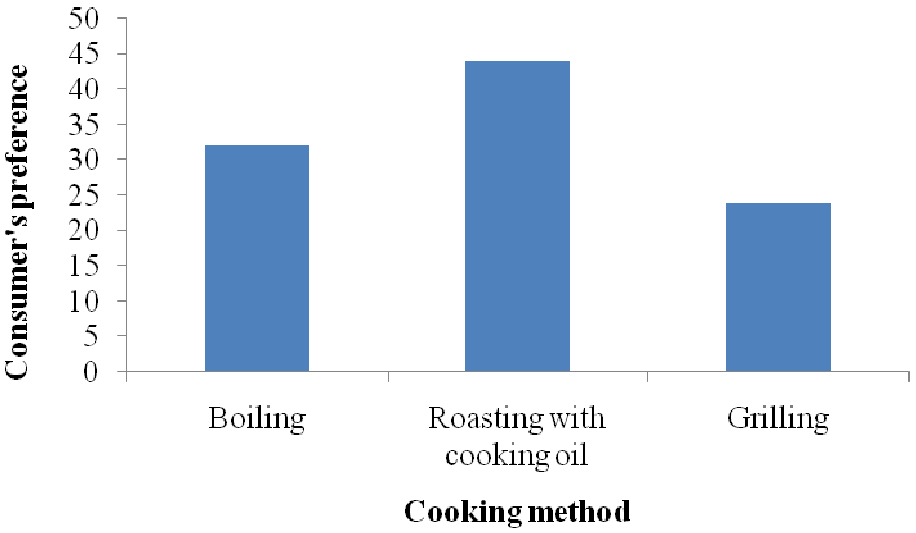


Figure 4: Major different preparatory or cooking methods that are used by local communities in Ikonda village as indicated by respondents during survey.

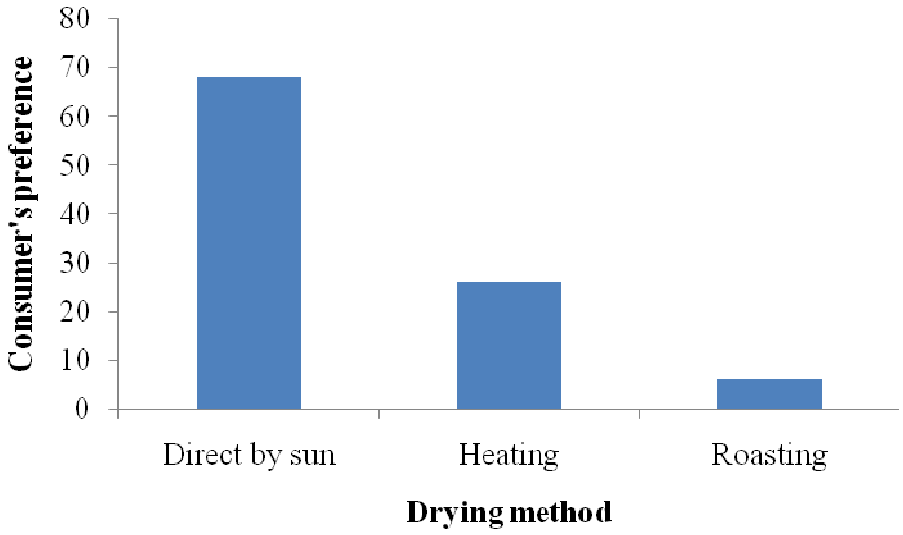


Figure 5. Showing preservation methods for collected birds

27% preserved by heat drying and 6% do short time preservation by frying in oil. (Figure 5.)

Information on health risks

This study also made investigation by discussion with respondents about any information or any knowledge on health hazards known to be caused by consumption of sprayed birds and whether there is any case of effects ever reported in connection with this scenario. No any case ever reported and there was no awareness on pesticide residues that might pose health risk due to this behavior of taking sprayed bird as source of food.

Results from residues analysis

Gas chromatographic determination

Results from sprayed untreated samples showed some amount of fenthion residues demonstrated in the broad

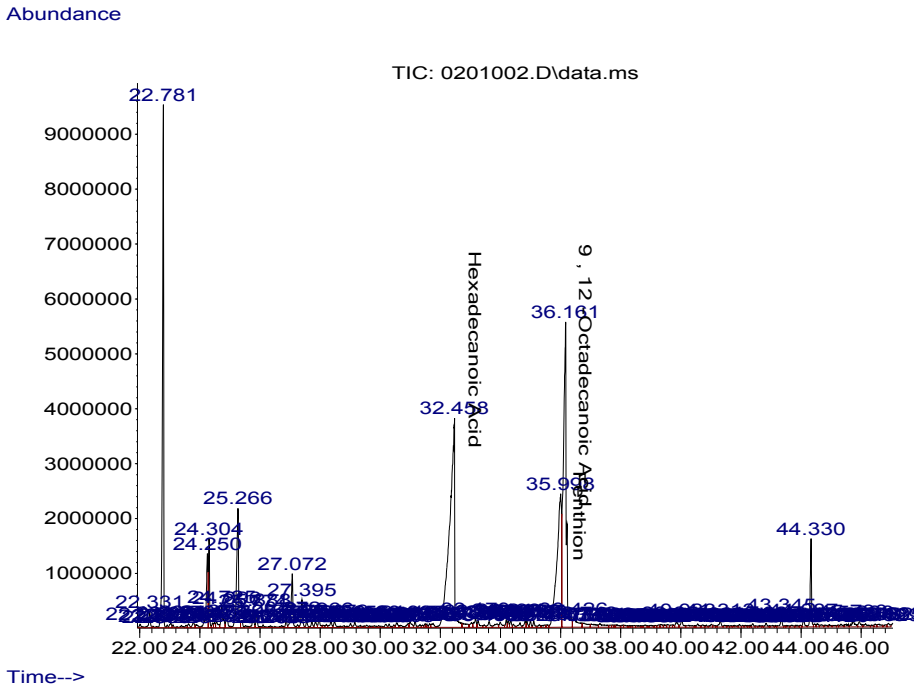


Figure 6. Quelea sprayed raw with Fenthion coeluted with 9, 12 - octadecanoic acid.

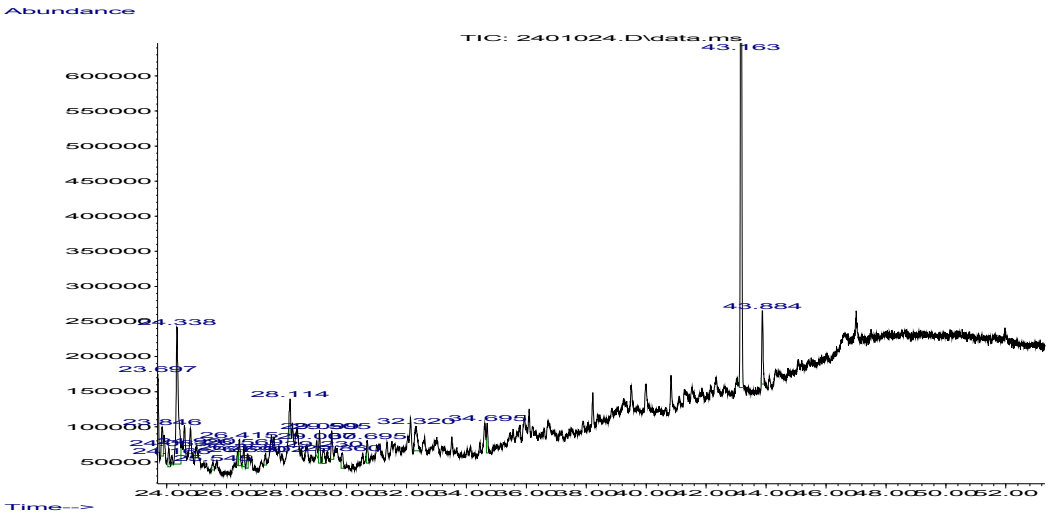


Figure 7. Chromatogram for samples of Quelea sprayed and boiled.

peak with fatty acids 9,12-octadecanoie acid which was believed to be contained in birds meat as demonstrated in figure 6.

The chromatogram in figure 6 showing some content of fenthion residues in sprayed raw bird samples that was not quantified by GC-MS as it colluded with 9,12-octadecanoic fatty acid which occurred very close to the fenthion's peak at retention time of 35.998 while the fatty acids peak occurred at 36.16 retention time. This peak is broad at the bottom which indicates that it contained more than one substance and was not possible to separate them. Proper cleaning of samples was repeatedly done, low temperature treatment of -196 degrees celcious liquid nitrogen whereby solvents was decanted but no fenthion peak was achived by GC-MS. It should be noted that organophosphates are lipopholic hence tightly adsorbed with fats.

There was a need to determine whether two cooking recipes of boiling and frying in oil had contributed to the reduction of Fenthion content in bird meat from sprayed and prepared samples in comparison to sprayed raw (uncooked). Results obtained showed fenthion residues below detection limit by the GC- MS for treated samples as demonstrated in below figure7.

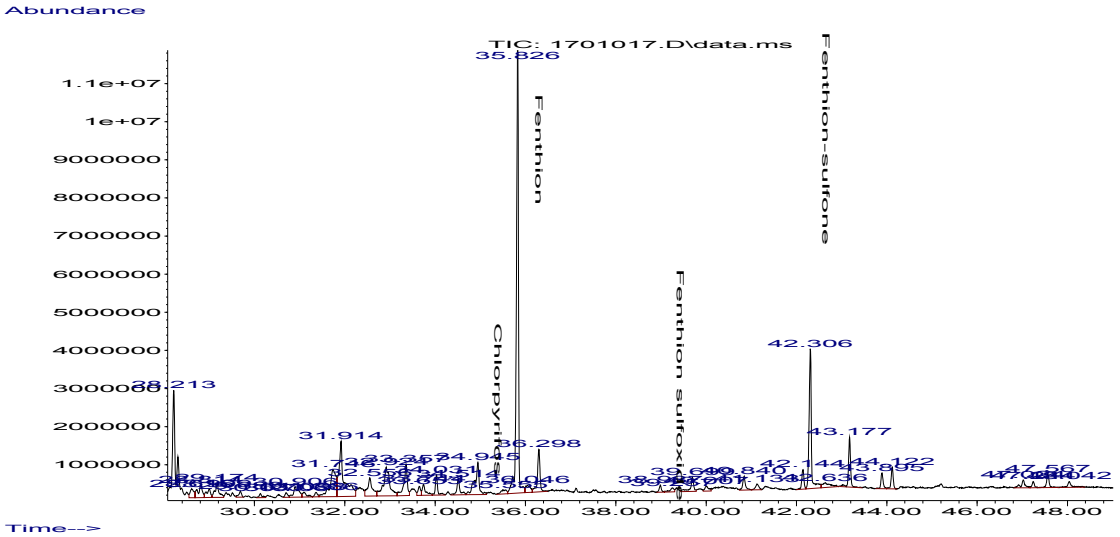


Figure 8. Samples fortified with fenthion and oxidized by Potassium permanganate solution.

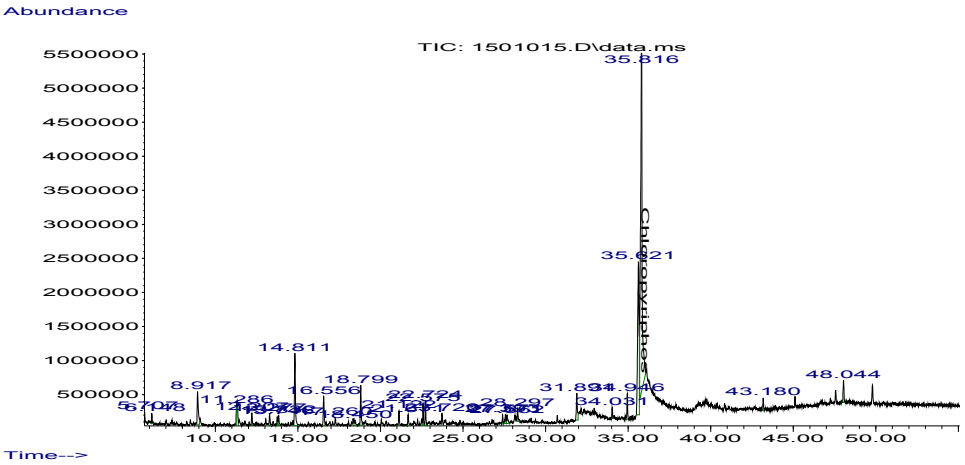


Figure 9. The recovery of internal standard Chloropyrifos in one of the analysed prepared sample.

The chromatography above demonstrates that there was very low fenthion residues below the detection by the GC-MS after bird samples treated by boiling. This means there is significant effect of the boiling process to the fenthion residues. To proof recovery of fenthion by GC-MS some cooked samples were fortified by fenthion which was then oxidized by potassium permanganate solution in order to justify the absence of fenthion. above is the results of fenthion derivatives as detected in figure 8.

Fenthion Oxidized to sulfone and sulfoxide with chlorpyrifos as internal standard (Proof for absence of fenthion in the sprayed and fried sample). The peaks obtained after oxidation of a fortified sample with chloropyrifos and fenthion were at retention time of 34.952 were Chlorpyrifos, on 40.0 for sulphoxide and on 42.316 was Fenthion-sulfone. The recovery percentage for the internal standards of pesticides used Chloropyrifos could be evident in chromatogram peaks as shown in Figure 9.

DISCUSSION

Fenthion

According to results obtained in this study, various preparation methods revealed significant effects in reduction of Organophosphate fenthion in sprayed birds used by some communities in Tanzania and Africa as

Table10. Summary of results in table showing treated and untreated samples

S/N	Recipe	Lab No.	Codes	Mean %recovery	Origin	Mg/fention
1	Boiling	1140-1149	SBO	84	Ikonda/ Basuto	< 0.0285
2	Cooked in oil	1150-1159	SCOL	86	--do--	< 0.0285
3	Raw	1160-1169	SR	82	--do--	Present co eluted with fatty acid, unknown quantity.
4	Control	1170-1179	CO	91	--do--	ND

source of protein. According to Cox (2000), Fenthion have water solubility of 4.2 mg/l at 20 ºC. Rapid degradation in water (half-life is approximately 1 days). There is elimination of residues in mammals by excretion of hydrolysis products. This means during soaking of samples in to warm water in the initial process of plucking and later washing before cooking indicated that some residue could have dissolved in water and washed away. The plucking as the foremost process by itself whether dry or wet reduces significantly the fenthion residues which would have been retained in feathers. Cleaning of carcasses with water before cooking, also played important role in fenithion residues reduction as fenthion to some extent dissolves in water. In comparative photodegradation study of fenthion and other pesticides, (Hirahara et al, 2001) observed that fenthion in the environment was more rapidly degraded by UV irradiation in natural sunlight than disulfoton. In this study, the most useful preservative method is sun drying, 67% of respondents. Plucked, eviscerated birds are sun dried in the house roof to the dry level as known by communities before taken and stored in the house.

Heat treatment

In this study, it has been revealed that cooking by both recipes had significant effects in fenthion residues reduction in sprayed birds used as source of protein. According to Sharma (2005), when pesticides contaminated food are subjected to various heat treatments such as pasteurization, boiling, cooking and grilling they tend to remove significantly the amount of residues. The loss of pesticide residue during heat processing may be due to evaporation, co-distillation, thermal degradation which vary with the chemical nature of the individual pesticide (Sharma et al. 2005). Some residual pesticides passed into cooking water from the plant materials according to their water solubility. For example, Nagayana (1996) observed that the residual organophosphorus pesticides in green tea leaves and spinach, strawberries, oranges and grape fruits were significantly decreased in leaching and cooking respectively. Other studies showed that incidence and stability of pesticide residues in some vegetables and fruits were affected by food processing
(El- Nabaraway et al. 2002)

CONCLUSION

According to physical and chemical properties of fenthion, of being water soluble by 4.2mg/l at room temperature various preparation methods done by communities taking sprayed birds as source of protein are significantly effective in reducing and sometimes eliminating residues. Many studies also showed good results in removal of Organophosphate pesticides applied in various crops including vegetables, fruits and cereal crops. Probably this is the reason as to why there is no any reported case of pesticide effects ever reported or observed in many parts of Tanzania and Africa where sprayed birds are taken as source of meat. Our conclusion based on this research is that the meat from sprayed quelea birds if prepared well is safe for human consumption. Although there is evidence on effectiveness of these preparation methods, we may not recommend for consumption of sprayed quelea birds instead recommendations are made for further research on all possible pesticide health risks. Therefore we accept the alternative hypothesis that preparation methods have significant effects in reduction of fenthion residues in sprayed birds for human consumption.

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