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Biomarkers, clinical and behavioral indicators of pesticide exposure in the district of DEKPO in Benin

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Introduction

- Pesticide poisoning is a major public health in rural developing countries and a significant burden on health services . In a recent WHO review, the global estimate of deaths due to pesticide poisoning was between 250-370000 each year .
- The vast majority of those deaths(99%) occur in developing countries, which use only a fraction: 20% of the worldwide marketed pesticides.
- The use of these pesticides has grown considerably since the end of the last decades.

Introduction (2)

- Especially In Benin, it has experienced an explosive growth of use of these pesticides due to the increase of cotton production. We registered those last decades, many cases of poisoning with deaths sometimes.
- The search for a preventive and diagnostic approach to these intoxications has been the basis of the present study entitled: "**Biomarkers, clinical and behavioral indicators of pesticide exposure** in the district of DEKPO in Benin".

1- Objectives

- Identify the pesticides faced by famers.
- Identify the farmers' risk factors for intoxication.
- Identify the clinical signs of intoxication that they present.
- Determine the level of acetyl cholinesterase activity and urinary alkyl phosphate of producers.

2- Frame work's study

Frame work's study: district named « DEKPO »

3- Methodology

- It's a cross-sectional study carrying out in 2007.
  For the study population sampling, we have done two degree of sampling:
  - the first degree: the selection of the area study
  - the second degree: the selection of the farmers

  For the biological analysis:
  - ➢ alkyl phosphates, they were dosed with the children because of the immaturity of their body and their high risk of poisoning. Those children have to met the following criteria:
    - Agricultural activities almost exclusive last 12 months
    - Be among the younger children
  - ➢ ACHE analysis

3- Methodolgy (2)

Area's selection

- By a reasoned sampling, the district of Dekpo was chosen **because it contributes for 48% of the total cotton production** of the departements. It's situated at 150km from Cotonou the capital.

Producers' selection

- The exhaustive census of the users of pesticides presents during the investigation (with at least 1 year seniority at work): all in all**, 76 farmers met the criteria** and fill in the questionnaire

Biological exams

- The day of sampling, there were **only 59 producers presents for the estimation of ACHE**
- For the **urinary alkyl phosphates**, they were dosed in children because of the immaturity of their body and their high risk of poisoning. **Only 10 children was concerned**.

3-Methodology (3)

- The data collection is based on:
  - ➢ A literature review,
  - ➢ Ministry of agriculture statistical
  - ➢ A questionnaire survey: A questionnaire-based survey handling practices and knowledge, attitudes, and self-perceived health effects of acute pesticide poisoning.
  - ➢ A clinical examination,
  - ➢ Biological analysis in blood and in urine (alkyl phosphate)

3-Methodology (4)

- In blood, ACHE activity were dosed
- In urine, we dosed alkyl phosphate urinary metabolites. There are six as follows:
  - ➢ O,O-dimethyl phosphate (DMP),
  - ➢ O,O-diethyl phosphate (DEP),
  - ➢ O,O-dimethyl phosphorothionate (DMTP),
  - ➢ O,O-dimethyl phosphorodithioate (DMDTP),
  - ➢ O,O-diethyl phosphorothionate (DETP),
  - ➢ O,O-diethyl phosphorodithioate (DEDTP).

  The analyses have been done at the laboratory of toxicology of Public Heath of Quebec in Canada

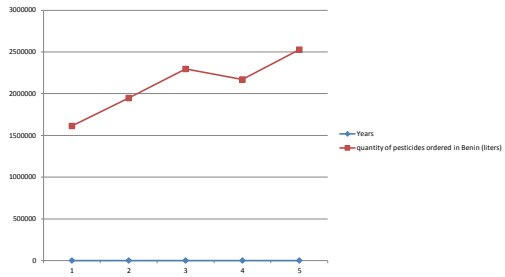
3-Methodology (5)

Statistical analysis

- ➢ Data were analyzed using the statistical program SPSS (Statistical Products and Service Solution, version 17.0). The electronic entry for each questionnaire was validated against the hard copy questionnaire sheets.
- ➢ A significance level of 5% were applied in the statistical analyses.
- ➢ Khi squarre of Pearson analyses were performed to assess the possibles associations.

4- Results and discussion

Fig N°1: National data on the quantity of pesticides ordered in five years



Results-discussion : Table 1: Nature of pesticides

TRADE NAME	COMPOSITION	CHEMICAL CLASS
Phaser plus	Endosulfan	Oc
Callisulfan	Endosulfan	Oc
Cotofan	Endosulfan	Oc
Thiodan ou phaser	Endosulfan	Oc
Thiofanex	Endosulfan	Oc
Thionex	Endosulfan	Oc
Alphacal P	Alphacypermethrin-profenofos	PY+OP
Dursban	Cyfluthrin-chlorpyrifos-ethyl	PY+OP
Cyflutralm P	Cyfluthrin -profenofos	PY+OP
Cyclofos	Cypermethrin-chlorpyrifos-ethyl	PY+OP
Nurelle D	Cypermethrin-chlorpyrifos-ethyl	PY+OP
Duel 232,5CE	Cypermethrin-profenofos	PY+OP
Polytrine	Cypermethrin-profenofos	PY+OP
Sherphos 180CE	Cypermethrin-triazophos	PY+OP
Duo	Cypermethrin H.C-profenofos	PY+OP
Déci T	Deltamethrin-triazophos	PY+OP
Curacron500EC	**profenofos**	**OP**

4- Results-discussion (3)

Nature of pesticides

- The pesticides used in Benin are mainly the insecticides. There are few herbicides and fungicides.
- Among the insecticides used, organophosphates and mixtures of organophosphates and pyrethroids are most frequently used.
- We noted also the use of organochlorine: endosulfan sold under several trade names. Endosulfan is banned in many countries.
- Those results are the same with CISSE in Mali and HOUETO in Benin(1990) , RAMA in south Africa (1995) and Payan-Renteria R. et al in Mexico (2012) were they found that the most used pesticides were mainly organophosphates, triazines and organochlorine compounds.

Table 2 : Sociodemographic caracteristics

CARACTERISTICS		FREQUENCY	%
SEX	**Males**	51	**67.1**
	Females	25	32.89
AGE	**≤ 15 years old**	29	**38.15**
	] 15-25 years old]	09	11.84
	] 25-35 years old]	15	19.78
	] 35-45 years old]	07	09.21
	] 45-55 years old]	08	10.52
	> 55years old	08	10.52
EDUCATION LEVEL	**Illiterate**	**47**	**61.84**
	Primary schooling	22	28.94
	Secondary school	07	09.21
SENIORITY	**] 0-5years [**	29	**38.15**
	[5 10 years]	13	17.10
	>10 years	34	44 .73

4- Results-discussion (4)

Sociodemographic characteristics

- The study population is constituted of 67% male and 33% female. That's in favor of our socio-cultural realities that want that in farming households, the man is mainly engaged in field work: results consistent with those of AFFEDJOU in Benin (1999).
- In contrast, whereas 38% of children were enrolled in our study, AFFEDJOU registered only 8%.

4- Results-discussion (5)

Table N°3: Risks behaviours of poisoning

PPE during pesticide applying?	Frequency	%
Yes	03	3.94
No	73	**96.05**
≠ NGOWI and MAEDA in Tanzania where only 4% don't use the PPE		

Farmer applaying pesticide

Child farmer applaying pesticide

4- Results-discussion (6)

Table N°4: Risks behaviors of poisoning

Safety measures taken against potential risks	Yes	%	Adequate measure?
Take bath only once arrived at home	75	**98.68**	No
Cutaneous massage with the red oil	52	**68.42**	No
Consumption of red oil	5	6.57	No
Consumption of milk	5	6.57	No
Consumption of alcohol	02	2.63	No
Consumption of honey	2	2,63	No

4- Results-discussion (7)

Table N°5: Risk factors of poisoning

Usage reserved to the pesticide can	Yes	%	Adequate measure?
Household purposes	32	**42.10**	No (dangerous)
Discharge in the nature	41	**53.94**	No
Burying in the ground	02	2.63	No

Empties Pesticide can to be sell in the market

Household purpose: Pupils using pesticide empties can for water bottle

Sociodemographic caracteristics

CARACTERISTICS		FREQUENCY	%
EDUCATION LEVEL	Illiterate	47	61.84
	Primary schooling	22	28.94
	Secondary school	07	09.21
SENIORITY	] 0-5 years [	29	38.15
	[5 10 years]	13	17.10
	>10 years	34	44 .73

4- Results-discussion (8)

Sociodemographic caracteristics Vs Risks factors	P value
Education level Vs **Use reserved to the empties pesticides can**	0.7
Education level Vs **Inappropriated protectives precautions taking by the farmers after pesticide applying** Hann Klith et al (2011) in cambodia, found that the higher educated farmers reduced their risks of poisoning by 55% for each extra personal protective measure they adapted	0.9
Seniority at work Vs **Use reserved to the empties pesticides can**	0.2
Seniority at work Vs **Inappropriated protectives precautions taking by the farmers after pesticide applying**	0.8

Table N°9 : **Reported self-perceived symptoms among the farmers**

	SYMPTOMS	N	%
	Urticaria	**58**	**76.31**
	Hot flash	**67**	**88.15**
SKIN SIGNS	Cutaneous burn	25	32.89
	Cough	21	27.63
RESPIRATORY SIGNS	Rhinitis	2	2.63
	Anorexia	27	35.52
DIGESTIVES SIGNS	**Nausea and\or vomit**	**44**	**57.89**
	Insomnia	36	47.36
	Difficulty making decisions	23	30.26
	Memory lapses	**55**	**72.36**
	Difficulty of concentration	**41**	**53.94**
	Dullness or Itch	**44**	**57.89**
	Feeling of weakness in certain parts of the body	15	19.73
	Feeling of tension or overstrain	6	7.89
	Feeling of nervousness when alone	5	6.57
	Headache	8	10.52
	Dizziness	3	3.94
	Nervousness or impression of shiver	**54**	**71.05**
	Dizzy spell	35	46.08
	Fits of uncontrollable anger	10	13.15
	Miss interest for everything	22	28.94
	Timorous attitude	34	44.73
NEURO-PSYCHIC SIGNS	Tendency to feel easily wounded	41	53.94

4- Results-discussion (9)

Reported self-perceived symptoms among the farmers

Symptoms experienced by producers are mainly :

- Skin signs with the hot flash (88.15%) and urticaria (76.31%)
- Neurological signs with memory lapses in the first position (72.36%)
- Gastrointestinal signs with nausea and / or vomiting (57.89%).

These results matches well to those of Lafia (1996), Affedjou (1999) in Benin, Payan-Renteria et al (2012) in Mexico, Zhang et al (2011) in China and Hanne Klith et al (2011) in Cambodia.

4 Results-discussion

- The clinical signs objectified are non specific for a possible exposure and / or pesticide poisoning.
- Nevertheless certain signs attract attention, this are:
  - Gynecomastia
  - Contact Eczema
  - Chronic bronchitis.

4- Results-discussion
ACHE level

	Males	Females	Children	p
Mean activity (UI/L)	13169.10	13068.26	10433.12	0.029

4- Results-discussion
ACHE dosage

- We evaluated the activity of ACHE only after spraying.
- The children ACHE level is lower than their parents' ACHE level, are much more exposed to pesticides.
- According to WHO, for a good interpretation of the ACHE activity, each subject should be its own control: ACHE test should be done before and after pesticide applying. We didn't do that, a limit of our study.

4- Results-discussion
Alkyl phosphate urinary metabolites dosage

Alkylphosphate	*% of détection*	*Min value (µg/gcreat)*	*Max value (µg/gcreat)*	*Mean (µg/gcreat)*	*Std deviation*
DEDTP	0	-	-	-	-
DEP	80	0,75	9,1	2,31	2,58
DETP	70	2,2	14	4,54	2,03
DMDTP	30	2,6	3,9	3,05	1,23
DMP	40	1,6	9,5	4,45	2,14
DMTP	90	4,7	18	8,65	1,61

The alkyl phosphate urinary concentrations are variable according to the child and the type of alkyl phosphate.

- DEDTP is not detected with the ten children.

The most frequent Alkyl phosphates detected are DMTP (90%), DEP (80%), the DETP (70%).

The least Alkyl phosphates detected are the DMDTP (30%) and DMP (40%).

4- Results-discussion
Alkyl phosphate urinary metabolites dosage

- The absence of DEDTP in the urine of ten children and the low percentage of detection DMDTP can be explained by the fact that they are rapidly converted into DMP and DEP.
- The percentage of the highest detection was observed with DMTP (90%) whereas Christina APREA and al (2000) in Italy, found the highest percentage of detection with DMP (96%). On the other hand, in the both studies the lowest percentage of detection was observed with DEDTP.

4- Results-discussion
Alkyl phosphate urinary metabolites dosage

- The No Observed Adverse Effect Level (NOAEL) It's 2888 mg / g of creatinine the day after the spraying and 2288µg/g of creatinine the seventh day following spraying.
- Our finds are 100 times below of that reference. This observation is the same as those of BOUDREAULT. D . et al, where there results are ten times lower than the reference.
- Certain authors have reported that the detection of urinary Alkyl phosphate does not provide specificity.
- Several recent studies documented the common presence of Alkyl phosphate in residential environments and foods.

5- Conclusion

- The use of pesticides in cotton fields leads to improved performance. Well cotton being the first export crop of our country, the use of pesticides has become too important in recent years. Unfortunately, this use is not subject to the suitable practices.
- The training of pesticide good practices has to be done.

5- Conclusion

- We have noticed a significant decrease of ACHE activity determined after the spraying period in children compared to adults.
- Alkyl phosphate urinary of ten children showed levels that are very below to the threshold.
- The Alkyl phosphate urinary metabolites dosage is appeared non specific.

THANK YOU FOR YOUR ATTENTION