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Investigation in the stakeholders, sanitary conditions and distribution channel of the small-scale production of tuna fish (*Thonidea*) in Côte d'Ivoire

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Abstract
This study focuses on the diagnosis of the artisanal tuna fish production from the open sea of Abidjan, southern Côte d'Ivoire. The investigation was implemented at field during 3 months in 2016 among the tuna producers from three fish working areas in Abidjan. Using dully filled questionnaires, 102 stakeholders were investigated regarding their profile, the fish reception, preservation and sale, and the handling and sanitary concerns. The workers involving in the tuna production channel are fishmongers, processers, and sellers, 91% to 97% of which are female gender especially Ivorians or Ghanaians. They are mainly younger with 50% to 94% below 35 years of age and displaying no rather formal education for sanitary management. Thus, the tuna working environment is generally insalubrious and fewer workers (below 35%) are aware of the lack of hygiene. The stakeholders also face other challenges as fish preservation (100%) and infrastructure (23% to 50%). Any assistance in cleansing of the working areas, sanitary training, more infrastructures development, and sanitary analyses are useful for providing high quality fish to consumers.

Keywords: artisanal fishing, tuna, stakeholders, production channel, Côte d'Ivoire

1. Introduction
Fishes are known to be significant source of food proteins over the world. In Côte d'Ivoire,, 15.9 kg of fish are yearly consumed per capita (Failler *et al.,* 2014) [1]. From overall fish species, the tuna (Tonidae family) is one of the most fished. The tuna fishing in Côte d'Ivoire is estimated at 300,000 tons/year. With this yield, the fishing Port of Abidjan is the head of tuna production in Africa (Romagny *et al.*, 2000, Failler *et al.,* 2014) [2, 1].
The tuna fishes are widely consumed thanks to their sensorial and nutritional advantages (Jain *et al.,* 2007) [3]. Several tuna species are reported, among which *Katsuwonus pelamis* called ''Listao'' has been accounting for 66% tuna fished in Côte d'Ivoire for long (Amon and Bard, 1989) [4]. The large scale production of tuna products is insured by big companies following sanitary standards. This production is generally for exports since the fish sale is more profitable in the developed countries compared to the local consumption. Hence, the local tuna market is supplied by two main ways: The tuna provided from large scale fishing but considered as under-grade product and rejected by the fish keeping factories and the tuna provided by the artisanal small-scale fishing also resulting in under-grade product without proper keeping conditions (N'da *et al.,* 2007) [1]. Indeed, the craft fishing is at the first range in the piscatorial production in Côte d'Ivoire with 63.37% captures volume in 2005. It's the main livelihood of numerous families and provides significant incomes (Nyebe *et al.,* 2014) [5]. Even though numerous statistics and information are available from the industrial tuna fishing in Côte d'Ivoire (Failler *et al.*, 2014) [1], those deriving from the craft fishing are rare and any information is reported about the organization and the structuring of the craft fishers. Consequently, the main stakeholders in the craft tuna fishing are yet unknown by consumers.
Moreover, the tuna found on the local market are known as ''fake tuna'' by specialists, accounting fake sanitary management conditions. The standards regarding the hygiene sanitary framing the tuna production are not rather monitored (Anihouvi *et al*., 2005, N'diaye, 2013) [7, 8], when the fish is known to be highly perishable food, especially in tropical regions without substantial keeping tools (Edou, 1993) [9]. In fact, the tuna post-capture management processes, namely the fish receipt, processing, keeping, and sale rely on significant effects on the

merchant and hygienic quality of the fish. In such environmental conditions, many microbes are still proliferating, such as histaminogen bacteria causing histidine decarboxylation and production of histamine, a toxic chemical agent for humans (Malle, 1996, Kouakou *et al*., 2013) [10, 11]. The post-capture management of the tuna fish is therefore a significant trend for supplying the market with good quality product. Still, a deeper knowledge gathered from the Listao tuna production and supply channels could lead to consideration of due policies for supporting such production projects.

This study aims to provide indicators regarding the sanitary conditions and the stakeholders involving in the small-scale production of piscatorial resources.

2. Materials and Methods

2.1 Investigation design

The study consisted in investigation at field implemented from the tuna craft producers in Abidjan District, which holds the biggest pole of landing and consumption of piscatorial products in Côte d'Ivoire (FAO, 2003) [12]. Three production sites were considered, namely sub-communes of Abobo-doumé, Zimbabwe, and the fishing port of Vridi from respective communes of Attecoubé, Port-Bouet, and Treichville, and where intense tuna production, processing, and trading activities are accounted. Hundred and two (102) stakeholders were investigated from the overall sites, 34 stakeholders in each, using dully filled questionnaires charted on investigations sheets. Only stakeholders operating beyond the tuna fishing, especially for the product processing and keeping were visited according to their availability and accessibility. The adherence to a cooperative and the holding of significant sale area were the other major criteria for selecting investigated traceable stakeholders.

2.2 Investigation implementation

The study was achieved for three (3) months in 2016. The requested information focused on the stakeholders profile (gender, age, nationality, type of activity) and the handling and sanitary concerns. Besides, a four points rating scale was drawn for the environmental sanitary responses regarding the fish reception, keeping and sale.

2.3 Data analysis

The data were recorded and statistically treated with Statistica software (STATISTICA 7.1). The statistical analysis consisted in Chi-square (X^2) non parametric test comparing the rating percentages resulting from each parameter at 5% significance (Deigna *et al*, 2016) [13].

3. Results and Discussion

3.1 Results

3.1.1Tasks and gender in the fish working

The stakeholders operating downstream the tuna production for local consumption were gathered into three main groups. There are fishmongers, fish processers, and fish sellers. Some polyvalent workers are involved at two or three levels (table 1). The fishmongers were the most represented tuna workers with mean of 50.65% responses. They're more represented (p<0.001) from Vridi (75%) but only account for 30% from Zimbabwe. From Zimbabwe site, the tuna processers (50%) were higher (p<0.001) compared to the other tuna workers (20% to 30%) and compared to the tuna processers from both Vridi (15%) and Abobo-doume (26.5%) sites. The tuna sellers accounted for 5% to 22% tuna workers. The data also revealed 26% and 22% polyvalent fish workers from respective Zimbabwe and Abobo-doume sites and only 10% for Vridi. However, significant difference (P<0.001) has been recorded for the gender of the workers from the sites investigated. The tuna post-production working looked like a gender activity with percentages of 91% to 97% females against only 3% to 9% male workers (Table 1).

3.1.2 Individual information of tuna stakeholders

Whatever the site investigated, various ages groups were recorded, the most rated of which was 25-35 years (44% to 53%). The figure 1 reveals younger tuna stakeholders below 35 years of age from Zimbabwe (94%) compared with those from Vridi (79%) and Abobo-doume (50%).

Regarding the nationality, the results did not show any obvious change from the overall sites investigated (p>0.05). The tuna workers met from the sites were generally Ivorian citizens (44%) or Ghanaians (48%) against 5% Togolese and 3% Burkinabeses (figure 2). The results also showed the lower education level for the tuna workers from Zimbabwe with 82% illiterates and 18% primary education level. Besides, Vridi and Abobo-doume recorded 70% and 41% primary education and 16% and 26% secondary education, against 12% to 21% illiterates (Figure 3).

Table 1: Main tasks and gender responses (%) for tuna fish works in the sites investigated

Sites	Fish working tasks				Gender	
	Fishmongers	Fish processers	Fish sellers	Polyvalents	Female	Male
Abobo-doumé	47	26,5	26,5	22	97	3
Vridi	75	15	5	10	94	6
Zimbabwe	30	50	20	26	91	9
Average	50,67	30,5	17,17	19,33	94	6

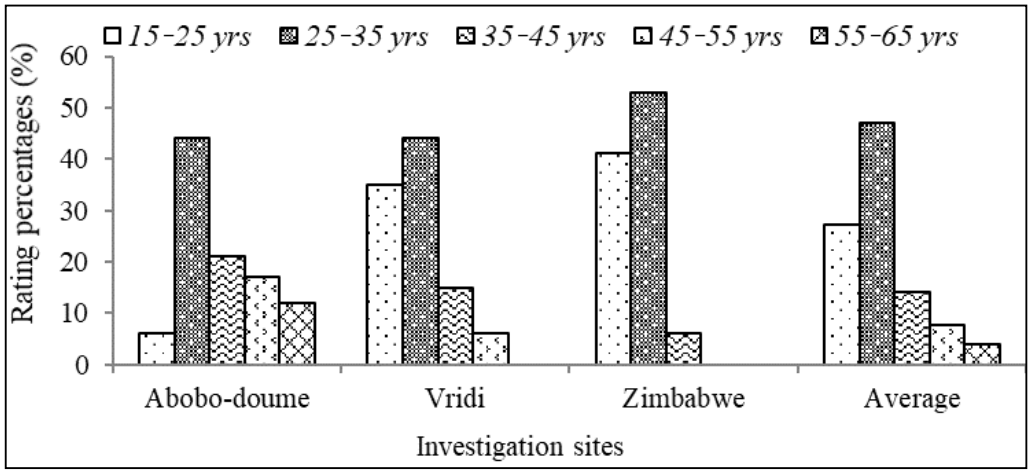

Fig 1: Ages groups of the tuna fish operators from the sites investigated

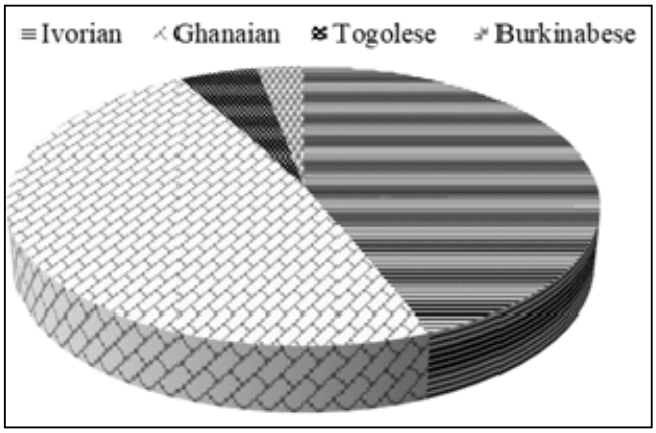

Fig 2: Nationality of the tuna fish operators from the sites investigated

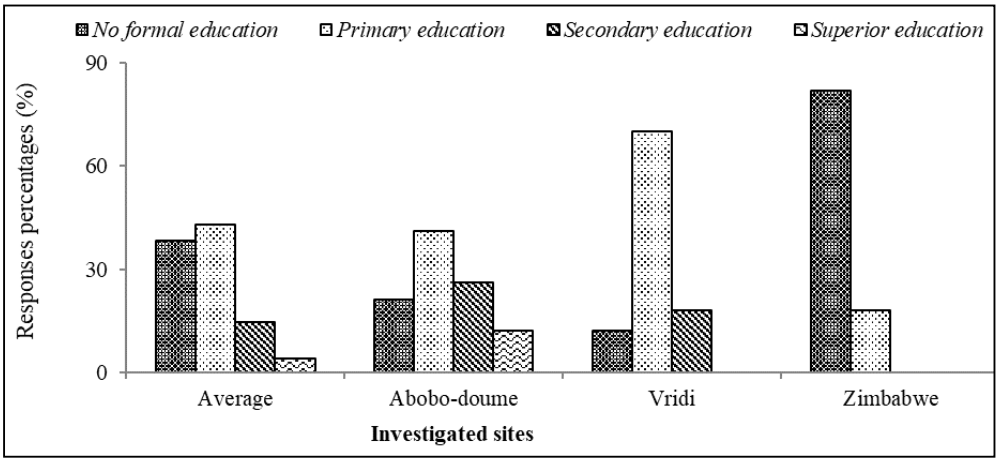

Fig 3: Education levels of the tuna operators from the sites investigated

3.1.3 Data of tuna fish supply

The tuna was supplied from the small-scale fishing, the industrial fishing or both fishing ways, with invarious percentages (table 2). The fishes were provided from wholesalers (57%), from the fishing boat (35%), and even from the landing waterfront (8%). During the supplying, 17% resellers rated to get only tuna fish species, while 82% resellers usually receive tuna fish and other fish species like deep-sea fishes. But, the tuna remains the most provided fish on overall sites. Sixty three percent (63%) fish traders were supplied with overall tuna and close fish species, whereas 23% responded for major tuna species and 14% for lower tunas. In addition, the most rated prices for tunas oscillated between 1000 and 10,000 XOF/batch (57%). But for 43% sellers, the tunas were measured and purchased using smaller pan (17%) or bigger pan (26%) over 20,000 XOF each

3.1.4 Keeping trend of tuna fish

The tuna working areas investigated were generally insalubrious. Zimbabwe displayed the most unsanitary site with a score of 1 on the 4 points rating scale. The less unsanitary site for the tuna working was found at Vridi with a

rating score of 3 out of 4 (Table 3). The major constraints rated by tuna workers from the sites visited (100%) deal with the fish keeping.

Table 2: Main information of the tuna provision rated by the resellers investigated

Indications	Rating Percentage (%)	X^2	P
Tunaorigin	Small-scale fishing (43%)–Industrial fishing (30%)–Small-scale and Industrial fishing (27%)	4.03	0.133
Way of tuna reception	Boat (35%)–waterfront landing (8%)–wholesale storage (57%)	90.11	<0.001
Fish types received	Only Tuna (17%) - Tuna and other fish species (82%) – Only other tuna species (1%)	1089.8	<0.001
Tuna types received	Major Tuna (23%)–Overall tuna (63%)-Fake tuna (14%)	45.31	<0.001
Tunapurchase	Batch (57%) – Small pan (17%) – Big pan (26%)	27.58	<0.001

Table 3: Sanitary traits and constraints of the Listao tuna production

Sanitary parameters	Abobo-doume	Vridi	Zimbabwe
General Hygiene Index of the site	2/4	3/4	1/4
Expression of lack of hygiene (%)	25	33	15
Fish preservation difficulties (%)	100	100	100
Lack of infrastructures (%)	40	23	50
Other Constraints (%)	5	7	4

More sanitary deficit (33%) has been mentioned from Vridi compared to Abobo-doume (25%) and Zimbabwe (14%). The lack of infrastructures was rated by 50% tuna workers from Zimbabwe and 40% and Abobo-doume; while only 23% displayed fish storage concern in Vridi. Other concerns related to the lack of official policies and technical assistance and the health delicacy have also been told, with percentages between 4% and 7% (Table 3).

For 89% resellers, the tuna was stored during processing before the sale, whereas lower rate of stakeholders (11%) rated for direct sale without any storage. Different storage techniques for fish keeping have been reported, the most widespread of which consists in the freezing storage. This technical is usually performed with addition of salt (27%) or/and steaming (29%) as shown in table 4. But, the fish was generally stored for below one week from the overall sites.

Table 4: Storage date of tuna fish rated by the overall stakeholders investigated

Indications	Rating percentages (%)	X^2	P
Fish Storage	Yes (89%) - No (11%)	155.36	<0.001
Storage technical	Any (5%) - Freezer (18%) - Steaming (21%) –Freezer and salt (27%) –Freezer and salt and steaming (27%) –Freezer and steaming (2%)	35.13	<0.001
Storage duration	< 24 h (54%) –Close to 48 h (7%) –Close to 72 h (5%) –Close to 1 week (29%) –Close to 1 month (5%)	92.8	<0.001

3.1.5 Trading parameters of tuna fish

From the overall sites investigated, the tuna was generally sold fresh or after steaming. The steamed tuna was reported to be more requested by the customers. The fish trading is differently achieved (X^2=36.3; P<0.001) from the provision site (11%), the storage site (50%), or both provision and storage sites (39%). The main customers are the direct consumers (24%), the 2nd order wholesalers (18%), and 41% for both direct consumers and 2nd order wholesalers (table 5).

Table 5: Data from the tuna fish rated from the overall sites investigated

Indications	Rating percentages (%)	X^2	P
Aspect of the Tuna for sale	Fresh (57%) - Steamed (43%)	36.3	<0.001
Trading design	From the provision site (11%)	1.99	0.15
	From the storage site (50%)		
	From both provision and storage sites (39%)		
Type of Customers	Direct purchasing (24%)	51.71	<0.001
	1st order wholesale purchasing (9%)		
	2ndorder wholesale purchasing (18%)		
	Direct and 1st order wholesale purchasing (8%)		
	Direct and 2nd order wholesale purchasing (41%)		

4. Discussion

The survey revealed that the tuna production channel from the landing till the sale is dominated by women from the overall sites visited. The economy of the craft tuna fishing could therefore contribute to the social and financial autonomy of women. This sector provides numerous profitable opportunities as trades and restaurants (Tallec and Moustapha, 2006) [14]. Except the tuna fishing tasks exclusively worked by men, other investigations also showed the greatest involvement of women in the tuna post-fishing treatment at three main stages. The fishmongers located at the beginning channel and directly receive the fish from the fishing boats and sell it to the other stakeholders. The middle channel tasks are the tuna producers who use various processes for keeping the fish. The fish traders appear at the top end of the tuna channel for marketing the fish to the customers (Belhabib *et al.,* 2012, CAOPA, 2012, N'diaye, 2013) [15, 16, 8]. Such observations agree with the FAO's reports relating to the women's contribution in the activities of the small-scale fishing in Volta coastal countries showing that the fishmongers and processers are mainly women (FAO, 2015) [17]. Because of the hardness and risks dealing with the fishing, women are usually at downstream of the production channel which accounts lower risks. However, some women involve at upstream of the fish production channel with financial support of the crafts and others are fishing dugouts owner (CAOPA, 2012) [16].

The craft fishing in Abidjan is dominated by western African

where Ghanaians (48%) are numerous compared to local citizens (44%). In fact, fishing is a main activity for Ghanaian coastal populations taught along generations (Adja, 2004; Kouakou *et al.,* 2013) [18, 11]. But from Ivorians, except the craft fishing in the lagoons, the populations were no more involved in the fishing activities for long (FAO, 2015) [17]. The great percentage of Ivorians found in the current investigation states on their raising interest in the fishing sector since some people from Ivorian coastal regions are accustomed to the fishing activities from earlier age while others are traditional fishers for home consumption and no more for trade (Adja, 2001) [19]. In addition, the local political and financial concerns resulted in the rising of jobless so that numerous local people turn towards the fish tasks as significant livelihoods.

Ninety four percent (94%) workers below 35 are involved in the tuna operations, showing that young people are more interested in this profession formerly worked by olders. Hence, it could be considered as a profitable activity. According to Kouakou *et al*. (2013) [11], the fishing tasks don't need any formal training and is taught by parents to progenies.

The rate of illiteracy is more significant on the site of Zimbabwe, a precarious township hardly accessible and accounting rare primary school so that many children do not have any means for formal education. The illiteracy from the fish workers is factor of their lack of interest regarding the sanitary concerns (Anihouvi *et al.,* 2005) [7]. However, the illiteracy from the tuna small-scale operators in Abidjan is lower than that recorded with the producers of ''*adjuevan*'' a local processed fish displaying 85.5%, 62.5%, and 53.3% of respective illiterate fishers, fish processers and traders (Kouakou *et al*., 2013) [11].

The craft fish working sites do not display only craft fishing product. They are provided from both craft and industrial fishing, since the craft small scale fishing is seasonal whereas the industrial fish is available along the year (Vangah *et al.,* 2002) [20].

The tuna consumed locally is known to be fake tuna usually resulting from the craft fishing. But, a significant part from the industrial fishing regardless any good storage criteria is also accounted. Such tunas are out-landed at the fishing port of Vridi and represent around 20% tuna yearly captures in Côte d'Ivoire (N'da *et al.*, 2007) [5]. It's in constant increasing, following the same distribution channel as the craft fished tuna (Fambaye, 2015) [21]. The tuna traditional fishers generally provide other fish species, namely deep-sea fishes, inner-sea fishes as striped fish and sole. So, the craft fishing float could target overall piscatorial resources (Failler *et al.,* 2014) [1]. Nevertheless, tuna remains the most received fish on the sites visited, especially from Vridi and Abobodoumé where a tuna department has been casted (CAOPA, 2012) [16].

The sites investigated are provided with different types of tuna. The craft fishing in Côte d'Ivoire is mainly constituted of lower *thonidea* captures. They are represented by various species as Thonine (*Euthynnus alletteratus*), Auxide (*Auxisthazard*), Fish banana (*Elagatis bipinnulata*), Baliste (*Balistes* spp.), and Barracuda (*Sphyraena* spp) with greater value-added for local populations. Oppositely, the industrial fishing provides major *Thonidea* species as Listao (*Katsuwonus pelamis*) locally spelled ''Nescao'' or ''kpokoukpokou'', Albacore (*Thunnus albacares*) or yellow tuna, Patudo or obese tuna (*Thunnus obesus*), and Germon (*Thunnus alalunga*) or white tuna. These tuna species were previously reported (Failler *et al*., 2014) [1]. The Listao tuna is largely enjoyed by consumers of *Garba*, a local cassava meal.

The tuna is usually sold fresh to some stakeholders as ''*garba*'' producers, individual consumers, and wholesalers. But, for the inner country populations, it's steamed for better preservation before the sale. Such a processing involves the greatest rate of tuna captures.

The tuna is also sold at various prices according to the size and quality. The lower tunas are batched for 1,000 to 10,000 XOF. Regarding the bigger and more valuable major tunas, measures are achieved with pans over 20,000 XOF.

Overall workers investigated rated the storage difficulties, especially during the top fish production season. In this case, many operators resort to various processing methods for keeping their fishes over periods, thanks to their ability to work at different levels of the production channel as shown by Djessouho (2015) [22] regarding the small-scale fish production in Benin. Other difficulties relating to the lack of storage and sanitary conditions are mentioned by the tuna fish operators even though numerous small-scale fish workers do usually ignore or neglect the basic sanitary rules (Nayeem *et al*., 2010, Abochi, 2010) [23, 24]. The sale areas are not also rather healthy, especially from the site of Zimbabwe with a deteriorated ground and many litters. The fish out-landing and carving areas are unhealthy in Abobodoumé. From Vridi, the soil is really tarred and the fish is often kept in fitted freezers but without any sanitary precaution. Such concerns are shared by the stakeholders of *Sardine* and *Guedj* fishes in Senegal (Diei-Ouadi, 2005, Falland Tounkare, 2014) [25, 26]. The lack of training, lack of information, and the sanitary quality of the fishes are also rated by some tuna producers may be of higher education level. Such subjects forecast on the health delicacy of the workers due to their long exposure to the fish smoke in unhealthy environments.

Prior to the sale, the tuna is processed for preservation against biological and sensorial degradation (Kouakou *et al.*, 2013) [11]. The freezing with ices and old freezers carcass are worked by some stakeholders. But the steaming with or without addition of salt is commonly performed by the fish traders as also reported from Burkina Faso and Senegal by Kabre *et al*. (2003) [27] and N'diaye (2013) [8]. The adding of salt during the storage processing is for the putrefying fishes. It leads to the production of fermented fish or *Adjuevan* in Côte d'Ivoire (Kouakou *et al.*, 2013) [11]. Such a technical is afforded against the fish losses.

5. Conclusion

Although the craft small-scale fishing is former in Côte d'Ivoire, this production channel is fragmentary. Yet it's the main source of piscatorial products for the local consumers with a casual distribution channel. Besides, the lower tunas are the most numerous tuna species provided to traders which major gender is female. The tuna works are operated in unhealthy environments that could result in sanitary hazards for the consumers. Numerous difficulties in the fish preservation, the sanitary system and the lack of infrastructures are rated. Any assistance in the cleansing of the working areas, sanitary training, and development of more infrastructures should be really affordable for providing good quality fish to consumers.

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