


Chemical Characteristics and Microbial Quality of *Guedj* a Traditional Fermented Fish from Senegal

N. G. Fall^{1,3} , L. S. Tounkara¹, M. B. Diop², A. Mbasse¹, O. T. Thiaw³, P. Thonart⁴

¹Institut de Technologie Alimentaire (ITA), BP: 2765, Dakar, Sénégal

²Université Gaston Berger (UGB) (UFR S2ATA), BP 234, Saint-Louis, Sénégal

³Université Cheikh Anta DIOP (UCAD) (IUPA), BP : 45784, Dakar, Sénégal

⁴Université de Liège Gembloux Agro Bio Tech (CWBI), Passage des Déportés, 2 B-5030 Gembloux, Belgique

Abstract: The present study aimed to estimate the chemical characteristics and microbial quality of traditional Senegalese fermented fish produced locally and known as *Guedj* which was prepared by using three types of fish: fatty fish (Machoiron or catfish or *Arius latisculatus*), medium fat fish (Capitaine or *Pseudotolithus brachygnatus*) and lean fish (Sompatte or *Pomadasys jubelini*). Samples were collected from three production areas located in Dakar, Thies and Fatick regions. The other samples were from Institute of Food Technology (ITA). Samples from ITA were used as controls. Results of test samples have shown significant differences in most chemical and microbial parameters when compared with those of the controls. Mean values of moisture contents, pH, TVB-N and NaCl of *Guedj* samples from the three production areas were significantly higher than those of the control (collected at ITA). Specifically: 1) moisture contents from Machoiron, Capitaine and Sompatte were 58, 42.60 and 26.90%, compared to controls 42.48, 35.60 and 24.40 %, respectively. 2) pH values were 6.56, 6.38 and 6.35 compared to controls 6.42, 6.28 and 6.28 respectively. 3) TVB-N values were 228.3, 308, and 334.8 compared to controls 155.4, 236.5, and 204.8 respectively. 4) NaCl contents were 10.75, 10.78 and 7.77 compared to controls 8.20, 7.80 and 6.56 respectively. Microbiological analyses showed that all test samples displayed higher microbial loads when compared to the control groups. We noted the presence of yeasts and molds, coliforms, pathogenic staphylococci, clostridia and lactic acid bacteria (LAB) in some of *Guedj* samples, but salmonella and *Vibrio parahaemolyticus* were absent. In conclusion the poor quality of the fermented fish, *Guedj* were mainly due to use of low quality spoiled fish as raw material, unhygienic procedures, the lack of standard operating procedures and adequate equipment, combined to improper salting and drying.

Keywords: Traditional fermented fish-*Guedj*, chemical characteristics, microbial quality.

Introduction

In Senegal, high temperatures coupled with lack or improper fresh food preservation infrastructures prompts the creation of artisanal processing industry of fisheries in order to avoid post-harvest losses. Thus traditional processes such as salting, braising, fermentation, smoking, drying and combinations of these treatments are used for preservation of fresh fish and other sea foods. Mbaye (2005) reported that in Senegal, 40% of landings from artisanal fishery are traditionally processed. It appears that artisanal processing is the only means of relatively simple conservation of unsold landings and waste. It stands as one of the most important means to improve living conditions of local populations living in rural areas and constitutes a viable source of income as

well. As a result, the traditional techniques of fish preservation contribute well to the achievement of food security (Fall et al., 2014). The quantity of processed fish products in 2011 was estimated at 49 881 tones with an Estimated Commercial Value (VCE) of 21,512,951 FCFA (VCE*1000) (DPM, 2011). The fermentation, one of the most economical methods was estimated at 7804 tones in this period (DPM, 2011).

There is a wealth of evidence showing that fermented fish is used sometimes as seasoning and at other times as the only source of animal protein in various dishes to replace meat and fresh fish (Toury, J et al., 1970); Mackie, I.M et al, 1971 and Essuman, 1992). They are commonly found in Africa under

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N. G. Fall (Correspondence)



nba@ita.sn



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several names like *Momoni*, *Koobi* and *kako* in Ghana, *Lanhouin* in Benin and Togo, *Adjuevan* in Ivory Coast and *Guedj* in Senegal (Nerquaye-Tetteh et al., 1978; Yankah, 1988; Anihouvi et al., 2005; Koffi- Nervy et al., 2011 and Essuman, 1992). They represent the majority of processed products in artisanal fisheries of South East Asia such as *Plaasoom* in Thailand (Kopermsub and Yunchalard, 2010) or *Nuocmam* in Vietnam (Hubert, 2003). These latter are now familiar condiment sauces in Europe (Hubert and Sabban, 2005).

The traditional Senegalese fermented fish, *Guedj* is obtained by spontaneous and uncontrolled fermentation as in the case of *Lanhouin* in Benin (Anihouvi et al., 2005) and *Adjuevan* (Koffi- Nervy et al., 2011). The name *Guedj* refers to a group of popular fermented fish products common to West Africa countries (Essuman, 1992). It is a fermented dried product light brown in color and characterized by strong pungent odor. It is used for both food and condiment added in small quantities to stews and soups for flavoring in cooking (Fall et al., 2014). Watanabe (1982) described the fermented fishery products in Senegal as highly salted and semi-dried fish products with an obnoxious odor and cheesy but rich fishy flavor reminiscent of kusaya from Japan. This product presents major economic assets that deserve much more attention. However the finished product has usually low quality and deteriorates rapidly during retailing and storage. The fish preparation is performed under generally poorly suited environments from the viewpoint of health (Die- Ouadi, 2005) and fresh fish is highly perishable product due to its biological composition (Baird, 2000; Gram and Dalgaard, 2002 and Diop et al., 2009).

In Senegal, there is no information about cases of poisoning resulting from the fermented fish consumption, however, the fermented fish can be considered as a potential vehicle of food borne diseases. So far microbiological and chemical quality defects are often associated to Senegalese fermented fish, *Guedj* and linked to processing technology (Lo, 1993; Seydi, 1991 and Fall et al., 2014). And information on chemical characteristics and microbial quality of *Guedj* are very limited.

To identify the above cited limitations, it would be necessary to assess the chemical characteristics and microbial quality of *Guedj* produced in several areas. Therefore, the purpose of this study was to evaluate the chemical characteristics and microbial quality of *Guedj* samples prepared with the three selected fish (fatty fish (Machoiron or catfish or *Arius laticulatus*), medium fat fish (Capitain or *Pseudolithus brachygnatus*) and lean fish

(Sompatte or *Pomadasys jubelini*) and collected from three production areas located at Dakar, Thies and Fatick regions.

Materials and Methods

Samples procedure

Three production areas located in Dakar, Thies and Fatick regions were selected as study areas. Their choice was guided by the fact that 54% of production of *Guedj* comes from these three regions (DPM 2011). In addition, the majority of the actors of the traditional fish processors live in those areas that have the largest production facilities, fishing piers and sales markets. The data obtained from these three production areas were compared with those from ITA.

Biological materials

Three selected fish Machoiron, *Arius laticulatus*; Capitaine, *Pseudolithus brachygnatus* and Sompatte, *Pomadasys jubelini* were used as biological material in this study. These fish are among the most commonly used species for making *Guedj* in Senegal. Machoiron samples were taken from Dakar and ITA, Capitain samples from Thies and ITA and Sompatte samples from Fatick and ITA.

The preparation of fermented fish in these production areas was fresh fish with relatively coarse salt. Two methods of production have been commonly used by processors. After evisceration, scaled, washed in running tap water and drained, the small whole fish was covered with salt and the big fish was opened wallet with brine salting and allowed to ferment at ambient temperature for 3 to 4 days before drying for 2 to 4 days.

Samples were taken at the beginning and the end of processing. They are recorded MP (fresh fish) and S_{72H} (fish taken after 72 hours fermentation and drying or *Guedj*). Machoiron, Capitain and Sompatte were codified as M, C and S respectively. For sampling purposes, five fish were randomly selected out of ten fish of each species. After thoroughly grinding and mixing, 500 g were used as sample. These samples were collected aseptically in sterile plastic bags and stored for further chemical and microbial analyses.

Chemical characteristics

The chemical characteristics were carried out in triplicates for all collected samples. The moisture, fat, proteins and NaCl contents were determined according to standard methods of AOAC / 945.15, 2003.06, 2001.11 and 937.09 respectively (AOAC, 2007). For pH measurements, 10 grams of samples were homogenized with 50 ml of distilled water and the pH of the homogenate was measured with a pH-

meter (Acorn™ Kit). The Total volatile basic nitrogen (TVB-N) was determined according to Antonacopoulos's method (1968) by direct distillation.

Microbiological Analysis

The total aerobic mesophilic flora (FMAT), thermotolerant coliform bacteria (CT), pathogenic staphylococci (SP), sulphite-reducing Anaerobe (ASR), salmonella (S), yeasts and molds (Y α M), *Vibrio parahaemolyticus* (VP) and lactic acid bacteria (LAB) were determined following the French standards (AFNOR, 2002), NF (ISO 4833, V08-060, EN ISO 6888-1, ISO 15213, V08-052, V08 059, ISO/ TS21872-1, and ISO 15214) respectively.

Twenty five (25) g of each sample were taken aseptically and homogenized in a stomacher () with 225 ml of BPW (10%). The diluted samples were spread on pre-poured agar plates (PCA), Violet Red Bile Lactose (VRBL) agar, Tryptose Sulfite Cycloserine (TSC) agar and Baird-Parker (B-P) agar for the isolation and enumeration of FMAT, CT, vegetative forms as well as spores from ASR and staphylococci spp. For ASR and staphylococci, plates were incubated at 37°C for 24 to 48 hours. VRBL plates were incubated for 24h at 44°C and PCA plates were incubated at 30°C for 3 days. Detection of salmonella was carried out after pre-enrichment in Buffered peptone, selective enrichment in Rappaport-Vassiliadis Broth and seeding on two growing media Xylose Lysine Deoxycholate and Hektoen agar. Plates were incubated at 37°C for 24 to 48 hours. Yeast and molds were identified on Yeast Extract Glucose Chloramphenicol (YGC) Agar and plates were incubated at 25°C for 72 to 120 hours. *Vibrio parahaemolyticus* (VP) identification was carried out in three successive phases: pré-enrichment on Alkaline Saline Peptone Water and Salt Polymyxin B Broth, isolation and identification on two selective media (Thiosulfate-Citrate-Bile-Saccharose and Triphenyltetrazolium Chloride Soya Tryptone) Agar. For isolation of LAB, the diluted inocula were plated out on Man Rogosa Sharpe (MRS) agar and the plates were incubated for 72 hours ±3 hours at 30°C. The enumeration of the strains was carried out using specific microbial techniques count of the marine microorganisms. The mean number of colonies counted for all microorganisms was expressed as colonies forming units (CFU) per gram.

Statistical analysis

All tests were carried out in triplicates for all the collected samples for proximate analysis and microbial counts and all standard errors of means were calculated with the EXCEL software.

Results and Discussion

Chemicals characteristics

The results of the chemical composition of the different types of fresh and *Guedj* samples collected at the three production areas located in Dakar, Thies and Fatick regions and ITA are presented in Table I.

The averages of the moisture content of the three fresh fish (Machoiron, Captain and Sompatte) from the three production areas were 79, 77 and 73%, respectively. They increased after fermentation and decreased progressively after sun drying down to final values of 58, 42 and 26% (Table I). However, these values were higher than that of the control samples (42, 35 and 24 %). It showed that the moisture content varied considerably according to the type of fish (lean, medium fat or fatty fish). The highest moisture content was recorded on fatty fish, Machoiron samples from Dakar (79%): the more fat, the higher moisture content and the drying time increases. According to Troller et al. (1978), the moisture contents of the samples ranging between 45 to 60% do not ensure the enzymatic and microbiological stability of the product.

The pH values measured in our tests are similar to those reported in the literature for this kind of products. It were ranging between 6.54 -6.89; 6.35-6.63 and 6.22-6.31 for the three fresh fish (Machoiron, Captain and Sompatte) and between 6.42-6.56, 6.28-6.38 and 6.28-6.35 for *Guedj* samples, respectively. No literature on the recommended pH range of African fermented fish products is available. Similar fermented fish known as *Pedah- Siam* is processed in Thailand (Yankah, 1988). The standard pH required for *Pedah- Siam* is 6.0-6.4, pH greater of 6.5 or higher is considered as a very poor quality product (Yankah, 1988). pH values ranging from 6.5 to 6.6 were noted by Koffi- Nervy et al., (2011) for the fresh fish (*chloroscombus chrysurus*) and from 5.2 to 6.1 for *Adjuevan* samples. Petrus et al. (2012) reported that the range of pH value of *Wadi Betok* (a traditional fermented fish from South Kalimantan, Indonesia) samples was between 6.74 and 7.87.

The evolution of the Total Volatile Base Nitrogen (TVB-N) follows the same trend as the pH. The averages values of TVB-N of the three fresh fish (Machoiron, Captain and Sompatte) were between 18.4 - 28.2, 29.6- 35.7 and 12.8 - 22.2 mg N /100g respectively. An increase was observed in the TVB-N value of all *Guedj* samples analyzed. The averages values of TVB-N of the *Guedj* samples collected at the three production areas (Dakar, Thies and Fatick) were (228.3, 308 and 334.7 mg N/100g) respectively. These values were higher than those taken at ITA which were 155.4, 236.5 and 204.8 mg

N/100g. That can be explained by the quality of the fresh fish used by women and the hygienic working conditions. Kerr et al. (2002) noted that the high TVB-N content reflects significant degradation of proteins. Similar values of TVB-N for fermented fish have been reported by other researchers on *Momone*, Yankah. (1998) and *Lanhouin*, Anihouvi et al. (2006).

The NaCl content of the *Guedj* samples collected at the three production areas (Dakar, Thies and Fatick) were 10.75, 10.78 and 7.77% respectively. The values of NaCl content were significantly greater than those taken at ITA which were 8.20, 7.8 and 6.56%. Traditionally, processors use much salt (unqualified and poor quality salt) during the fermentation of fish but also for sun drying by rubbing into the belly cavity, the gills and on the surface of the fish. Adams et al. (1987) noted that the high salt concentration slows the degree of fermentation. However, when the rate of salt used for fish fermentation is high, the surface of the fish becomes cuirassed and the movement of moisture from the deeper layers to the surface is prevented.

The protein contents of the three fresh fish (Machoiron, Captain and Sompatte) samples ranged between (17- 23.15%, 8.56-19.57% and 20.40-22%) and between (35-36%, 31-32% and 27-29 %) for the *Guedj* samples respectively for the tests carried in the three production areas (Dakar, Thies and Fatick) and ITA. Significant difference was noted between fresh fish and fermented fish. EL Sheikha et al., (2013) reported that the protein content of fermented fish ranges from about 18% to nearly 72% and it is depending on the water content. This makes the product a good source of animal protein.

The fat content of *Guedj* samples were between 8.12- 8.56%, 5.01-5.20% and 2.78- 3.01% for Machoiron, Captain and Sompatte respectively.

Microbiological Analysis

Data presented on Tables (II) show the microbiological characteristics of the different fresh fish and *Guedj* samples. The averages count of the FMAT present in the three fresh fish (Machoiron, Captain and Sompatte) were between 1.5×10^4 - 8.2×10^6 , 4.1×10^6 - 3.0×10^7 and 2.8×10^3 - 2.7×10^5 (cfu/g) respectively (Table II). It was observed that during fermentation, the averages count of the FMAT increases and then decreases with the sun drying for all the samples. The counts of the *Guedj* samples collected at the three production areas (Dakar, Thies and Fatick) were 5.2×10^6 , 1.6×10^6 and 3.7×10^5 (cfu/g) respectively. They were higher than that of the control samples (ITA) which were 1.1×10^4 , 3.5×10^5 and 6.0×10^4 cfu/g (Table II). But they are lower than

that reported by Lo (1993) of the *Guedj* sample which was 9.7×10^7 cfu/g. The high level of contamination of *Guedj* make from the three production areas may result from to the quality of the raw material and the salt used and the improper handling and sanitary conditions during processing.

Graduel decrease for the evolution of thermotolerant coliforms bacteria (CT) was observed during the sun drying in seventy-two (72) hours to averages <10 - 2.0×10^1 , <10 - 3.2×10^2 and <10 - 4.9×10^4 (cfu/g) for the Machoiron, Captain and Sompatte fish respectively (Table II). These averages are greater than those enumerated for the *Guedj* by Watanabe (1975) which are respectively less than or equal to 10 (cfu/g). The high presence of thermotolerant coliforms bacteria in *Guedj* production areas samples is witness of bad hygienic conditions of the processors.

The high contamination of yeasts and moulds for the *Guedj* samples from Dakar, Thies and Fatik respectively (10^2 ; 1.5×10^2 and 1.5×10^2) (cfu/25 g) (Table II) reflect the poor hygienic conditions during the drying and the storage. A lot of spoilage is experienced by processors during those stages due to the inadequate drying equipments and the humid conditions in warehouses. These microorganism spoilage are responsible of finished product destruction and may cause large economic losses.

For the pathogenic staphylococci (SP) count, 91.6% of the samples were less to 100 (cfu/g). The sulphite-reducing Anaerobe (ASR) count of the majority (66%) of the samples was less or equal to 10 (cfu/g). The presence of low density of pathogenic *staphylococci* and *Clostridium sp* contaminants in some of the fermented fish samples could be due to contamination and indicated that there is a need to improve handling and processing (Essuman, 1992). Indeed, microbiological analyzes carried out on the *Lanhouin*, fermented fish from Benin showed the presence of pathogens such as *Bacillus* and *Staphylococcus* (Anihouvi et al., 2006). Other authors have showed similar results on *Momoni*, fermented fish from Ghana (Nerquaye-Tetteh et al., 1978; Yankah, 1988, Abbey et al., 1994 and Sanni et al., 2002). However the absence of salmonella and *Vibrio parahaemolyticus* (VP) in all of fresh fish and *Guedj* samples reassures consumers.

The microbial evaluation made on the *Guedj* samples showed the presence of LAB which is between 10^4 and 10^6 cfu/g. Based on the results obtained no product have reached the level of LAB found in fermented fish at the literature. The values are very low to say that the fish are fermented. Dortu (2002) have reported similar number of LAB in the

Senegalese fermented fish. The pH which ranges from 6-7 confirms that the lactic fermentation is not predominant given that LAB acidifies the environment. Furthermore, the quantity of carbohydrates in fish is less than 0.5% which is very low for a lactic fermentation. This has already been noted by many authors including Martin, A (1996). It is recommended that the addition of carbohydrates to the fish in order to stimulate lactic fermentation. Carbohydrate addition is a common practice in Asia as the case of the Thailandais fermented fish product called *Plaa-som*. In this product, LAB reaches 10^8 - 10^9 cfu/g after three days fermentation to a salt concentration of 9%, acidification brings the pH to a value of 4,5. The growth of LAB in this case is facilitated by the addition of coconut sirup that is the fermentable source by the lactic acid bacteria, the strains used did not use the starch (Paludan- Muller et al., 2002). The combination of low pH and organic acids (namely lactic acid) is the main preservation factor in fermented fish products (EL Sheikha et al., 2013).

Conclusion

It appears from this study that the microbial and the chemicals quality of the *Guedj*, a traditional Senegalese fermented fish, highly variable and depends to hygienic conditions of production adopted by processors. There were significant differences between most of the samples when they were compared with the control samples (collected at ITA). Results from this study indicate the need to develop our own starter culture in the context of Senegal based on local factors, namely the initial charge of the capture environment, the type of product and the contamination due to various manipulations and surrounding hazards. Furthermore, the development of a microbial starter to ensure controlled fermentation could positively affect the health and organoleptic quality of the finished product. Thus the use of lactic acid bacteria "starter" as ferment associated with local amylaceous substrates "carbon hydrates" is a line of inquiry.

Conflict of interest

The authors declare no conflict of interest

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Table I : Chemical composition and pH Value of the fresh and fermented fish from Dakar, Thies, Fatick and ITA

MP (fresh fish) and S_{72H} (fish taken after 72 hours fermentation and drying or *Guedj*). The indices M, C and S correspond to the name of fish (Machoiron, Captain and Sompatte).

Fish	Samples type	Production area	Parameters					
			Moisture (%)	pH	Fat (%)	Protein (N*25) (%)	Salt (NaCl) (%)	TVB-N (mg N/100g)
Machoiron (Fatty fish)	MP _M (Fresh fish)	Dakar	79,64±1,2	6,89±0,04	5,80±0,3	17,19±0,9	0,45±0,05	28,2±0,8
		ITA	77,20±0,1	6,54±0,01	6,50±0,1	23,15±0,05	0,23±0,02	18,4±0,5
	S _{M72H} (<i>Guedj</i>)	Dakar	58,00±0,02	6,42±0,01	8,12±0,01	35±0,03	10,755±0,03	228,3±0,9
		ITA	42,48±0,01	6,56±0,02	8,56±0,01	36,30±0,01	8,20±0,01	155,4±0,01
Captain (medium fat fish)	MP _C (Fresh fish)	Thies	75,27±0,6	6,35±0,04	3,50±0,7	8,56±1,1	0,22±0,02	33 35,7±1,1
		ITA	77,50±0,1	6,63±0,01	3,36±0,1	19,57±0,1	0,26±0,01	29,6±0,4
	S _{C72H} (<i>Guedj</i>)	Thies	42,60±0,02	6,38±0,03	5,01±0,02	31,08±0,02	10,78±0,04	308±0,0
		ITA	35,6±0,03	6,28±0,02	5,20±0,01	32,79±0,01	7,80±0,02	236,5±0,4
Sompatte (lean fish)	MP _S (Fresh fish)	Fatick	72,25±1,4	6,31±0,01	0,46±0,02	20,40±0,01	0,23±0,03	12,8±0,2
		ITA	73,12±0,7	6,22±0,02	0,53±0,01	22,39±0,03	0,12±0,02	12,8±0,2
	S _{S72H} (<i>Guedj</i>)	Fatick	26,9±0,01	6,35±0,01	2,78±0,01	27,29±0,03	7,77±0,01	334,7±0,0
		ITA	24,4±0,01	6,28±0,01	3,01±0,01	29,15±0,01	6,56±0,03	204,8±0,01

Table II: Microbial quality of the fresh and fermented fish from Dakar, Thies, Fatick and ITA

MP (fresh fish) and S_{72H} (fish taken after 72 hours fermentation and drying or *Guedj*). The indices M, C and S correspond to the name of fish (Machoiron, Captain and Sompatte); Abs: absent.

Fish	Samples type	Production area	Parameters							
			FMAT (CFU/g)	TC (CFU/g)	SP (CFU/g)	SRC (CFU/g)	S (CFU/25g)	Y α M (CFU/25g)	VP (CFU/g)	LAB (CFU/g)
Machoiron (Fatty fish)	MP _M (Fresh fish)	Dakar	$8,2 \cdot 10^6 \pm 1,8 \cdot 10^4$	<10	<100	<10	Abs.	$1,4 \cdot 10^1 \pm 0,2 \cdot 10^1$	Abs.	<10
		ITA	$1,5 \cdot 10^4 \pm 1,2 \cdot 10^3$	$8,0 \cdot 10^3 \pm 1,7 \cdot 10^2$	<100	10	Abs.	$5,1 \cdot 10^1 \pm 2,0 \cdot 10^1$	Abs.	$4,8 \cdot 10^2 \pm 1,0 \cdot 10^1$
	S _{M 72H} (<i>Guedj</i>)	Dakar	$5,2 \cdot 10^6 \pm 1,0 \cdot 10^5$	$2,0 \cdot 10^1$	<100	<10	Abs.	$10^2 \pm 0,0$	Abs.	$5,2 \cdot 10^5 \pm 3,2 \cdot 10^3$
		ITA	$1,1 \cdot 10^4$	<10	<100	<10	Abs.	<10	Abs.	$6,0 \cdot 10^2 \pm 0,3 \cdot 10^1$
Captain (medium fat fish)	MP _C (Fresh fish)	Thies	$3,0 \cdot 10^7 \pm 2,7 \cdot 10^6$	$4,8 \cdot 10^3 \pm 3,8 \cdot 10^2$	$1,0 \cdot 10^2 \pm 2,1 \cdot 10^1$	$1,410^3 \pm 3,6 \cdot 10^2$	Abs.	$2,6 \cdot 10^2 \pm 1,0 \cdot 10^1$	Abs.	$3,2 \cdot 10^2 \pm 10^1$
		ITA	$4,1 \cdot 10^6 \pm 1,2 \cdot 10^5$	$2,0 \cdot 10^3 \pm 10^2$	<100	<10	Abs.	$3,2 \cdot 10^1 \pm 1,0 \cdot 10^1$	Abs.	$7,5 \cdot 10^3 \pm 2,4 \cdot 10^1$
	S _{C 72H} (<i>Guedj</i>)	Thies	$1,6 \cdot 10^6 \pm 3,6 \cdot 10^5$	$3,2 \cdot 10^2 \pm 28$	<100	$2,4 \cdot 10^2 \pm 0,0 \cdot 10^1$	Abs.	$1,5 \cdot 10^2 \pm 45$	Abs.	$5,6 \cdot 10^1 \pm 2,1 \cdot 10^1$
		ITA	$3,5 \cdot 10^5 \pm 1,3 \cdot 10^2$	<10	<100	<10	Abs.	<10	Abs.	$3,8 \cdot 10^2 \pm 1,2 \cdot 10^1$
Sompatte (lean fish)	MP _S (Fresh fish)	Fatick	$2,8 \cdot 10^3 \pm 1,1 \cdot 10^2$	$5,4 \cdot 10^2 \pm 1,1 \cdot 10^2$	<100	<10	Abs.	$1,12 \cdot 10^2 \pm 0,0$	Abs.	$8,8 \cdot 10^2 \pm 1,5 \cdot 10^1$
		ITA	$2,7 \cdot 10^5 \pm 1,4 \cdot 10^3$	$2,8 \cdot 10^3 \pm 1,1 \cdot 10^2$	<100	10	Abs.	$6,0 \cdot 10^1 \pm 0,4 \cdot 10^1$	Abs.	$9,3 \cdot 10^2 \pm 10^1$
	S _{S 72H} (<i>Guedj</i>)	Fatick	$3,7 \cdot 10^5 \pm 2,2 \cdot 10^4$	$4,9 \cdot 10^4 \pm 1,4 \cdot 10^3$	<100	<10	Abs.	$1,5 \cdot 10^2 \pm 23$	Abs.	$2,6 \cdot 10^2 \pm 1,9 \cdot 10^1$
		ITA	$6,0 \cdot 10^4 \pm 93$	<10	<100	<10	Abs.	<10	Abs.	$1,1 \cdot 10^2 \pm 1,2 \cdot 10^1$