THE EXTENT OF FOOD ADULTERATION AND CONTAMINATION IN GHANA

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ACCRA, GHANA.

November, 1989

ACKNOWLEDGEMENT

I wish to express my sincere thanks to officials of the Ministries of Health and Agriculture in all the regions visited and also to the management and staff of other Government establishments and organisations for their co-operation during this survey.

My thanks are also due to the numerous individuals and members of the general public who provided useful information without which this survey would not be complete.

Finally I am grateful to Miss Christiana Ketsie of the Food Research Institute for typing the manuscript.

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SUMMARY

This report presents the results of a field and literature survey on Food Adulteration and Contamination in Ghana. It is an extract from a consultancy assignment report carried out by the author for the Food and Agriculture Organisation (FAO) of the United Nations in 1989.

The results obtained indicate that Food Adulteration exists in most regions in the country being highly prevalent in "Ready-to-eat" foods, locally prepared alcoholic beverages and foodstuffs normally sold in the ground or milled forms. Adulteration was found to be common in big markets in the urban cities and was carried out basically with the ultimate aim of increasing the sellers' profit margin. Food items from all the commodity groupings are adulterated in one form or the other in the country. The various foods, their adulterants and the forms of adulteration are presented in this report.

Regarding Food Contamination, the survey showed that most traditional processing, preservation and preparation methods for foods are carried out under unhygienic conditions which are likely to lead to contamination of the final product. It came to light that fertilizers are sometimes misapplied and various pesticides are misused for hunting and fishing purposes in the country. Interviews with officials of various related Government establishments revealed that limited research work has been carried out on food contaminants such as the pesticide residues, heavy metals and fungal toxins in foods. The major constraint identified was the lack of appropriate equipment.

The results of the survey indicate an urgent need for the promulgation of food laws for the country and the establishment of a national food contamination monitoring programme backed with the relevant laboratory facilities and public education campaigns.

1. INTRODUCTION

The paramount role of food control and contamination monitoring services in the national food economy, food industries and in the national and international food trade cannot be over-emphasised. Every nation needs an effective food control service to promote a safe and honestly presented food supply and to protect consumers against foods which are contaminated, decomposed, or adulterated, or which may be injurious to health or are deceptively packaged or labelled with false or misleading statements or are otherwise fraudulent. To accomplish these purposes a nation needs laws to encourage the production of safe and wholesome foods and to prohibit the sale of foods which are unsafe or adulterated.

A lot of concern has been expressed by the Ghanaian press and public about irresponsible business practices by some food manufacturers such as the the turning out of shoddy goods, adulteration of foods, mislabelling and unlabelling of products, exposure of foods and the production and sale of foods unfit for human consumption. In addition, most Ghanaians are worried about the unhygienic conditions under which certain foods are prepared for sale in the country. Concern has also been expressed about the misuse of chemicals especially pesticides for fishing and hunting purposes and the damaging effects of the excessive and careless use of these substances on people and the environment.

Currently there is no food law in operation in Ghana making it difficult for food inspectors to check adulteration and other malpractices. The first time an attempt was made to pass a food law in the country was in 1963 and since then successive governments have recognised the importance of enacting such a law and establishing its administration to give special emphasis to regulations guiding the operations of food processors and their marketing agents so as to protect the health of consumers and minimise unfair and fraudulent practices in the food trade.

Presently, Ghana in collaboration with the Food and Agricultural Organisation (FAO) of the United Nations is in the process of establishing foods laws to augment existing food handling and marketing regulations of the district councils in the country. These laws are intended to check fraud and other malpractices by food manufacturers and also to ensure that wholesome foods are offered for sale to the public under the most sanitary conditions. It is in this light that the FAO initiated this project to collect adequate background information on the extent of food adulteration and contamination in Ghana. This information is to serve as a database to be used in the drafting of food standards to be incorporated into food regulations and codes of hygienic practices for the country.

2. METHODOLOGY

2.1 Data Collection

The consultant after a briefing in the FAO Regional office for Africa in Accra, Ghana, visited eight of the ten regions of Ghana. The regions visited were Central, Western, Ashanti, Brong-Ahafo, Eastern, Volta, Northern and Greater Accra regions. It was not possible to visit the Upper East and Upper West regions due to incessant rains resulting in the flooding of several parts of these regions.

Relevant data was collected from officials of various Government establishments and departments, universities, markets, traditional food processors and from members of the general public.

Questionnaires were developed to help in the collection of data on the following:-

Forms of adulteration

Adulterants used in various foods

Reasons for the use of adulterants

Knowledge about possible harmful effects of adulterants on the health of consumers.

A partial list of persons encountered during this assignment is given in Annex 3.

2.2 Visits to markets and traditional food processing sites

The consultant visited markets in all the regions listed and collected data on adulteration of various food commodities. Handling practices of food items in the markets were observed.

Some traditional food processing sites were visited. Food processing and handling practices were observed and those found likely to lead to contamination of the final products noted. Interviews were conducted with the processors and in a language in which the respondents were fluent. The help of local interpretors was sought where necessary.

2.3 Visits to Government establishments

Visits were made to various Government establishments and discussions had with their officials. The establishments included the Ministries of Agriculture and Health, Ghana Standards Board, Environmental Protection Council, Ghana Atomic Energy Commission and the Universities of Ghana and of Science and Technology. The discussions centred around the misuse of agro-chemicals especially fertilizers and pesticides in the country and the extent of work done regarding the monitoring of levels of contaminants in foods.

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3. ACTIVITIES AND MAJOR FINDINGS REGARDING FOOD ADULTERATION

3.1 General observations

Adulteration was found to be more common in big markets in the urban cities and towns than those in the rural areas and took various forms such as:

i) the incorporation of other foods relatively inexpensive and sometimes even parts of plants not normally consumed to increase bulk and enhance the traders' profit margin.

ii) the use of other foods, dyes and colours to disguise deteriorated or spoiled foods to give an idea of freshness to the buyer.

iii) the use of dyes and colours to create an impression to the buyer that a superior ingredient or food has been used.

iv) the use of parts of certain plants in locally produced alcoholic beverages to increase the stimulant effect.

v) the use of miscellaneous compounds such as sugar and sometimes even fruits of particular plants to impart certain properties to foods.

A general observation made in the markets was the abundance and sale of dyes and colours. Few sellers sold these colours in sealed and labelled containers. It was observed that various dyes and colours were just tied in pieces of polyethylene with no labels and openly displayed in all the markets. Colours which were sold in sealed and labelled containers were Sunset Yellow (E110), Ponceau 4R + Tartrazine (E124 + E102), Tartrazine + Sunset Yellow (E102 + E110), Tartrazine + green (E102 + SE142). All these colours were imported. Sellers of dyes and colours were always enthusiastic to give information regarding the used to which the various colours are put. All the sellers interviewed were however ignorant about the possible harmful effects of these colours.

Another colouring material and popular adulterant observed in all the regions was the ground seeds of the plant, Bixa orellana. This plant is called "Jena Brown" or "Soward" in the Ashanti region. The fruits are dried and the seeds removed and ground into a powder popularly called "tomato powder" throughout the country because of its red colour. These seeds are known to yield the Annatto of commerce, an orange or yellow dye used for colouring food such as cheese, butter and jellies among others. The Annatto seeds however have to undergo special preparation to make them perfectly pure and harmless(1). In my opinion therefore, crude milling of the whole seeds and their use in foods in the country is rather unacceptable and must be discontinued.

The detailed findings are presented in Section 3.2 by commodity groupings.

3.2 Adulteration by commodity groupings

3.2.1 Cereals and their products

(i) Maize

Maize is an important staple food in Ghana and is generally used as whole meal. It is soaked in water for two days after which the water is discarded and the grain ground into a fine flour. This flour is mixed with water and kneaded to form a dough which is spontaneously fermented for another two days.

Fermented maize dough is sold in most markets and is used for preparing various traditional foods such as porridge (koko) normally consumed for breakfast and used as a traditional infant weaning food, "kenkey" (cooked fermented maize dough balls) of which there are several types characteristic of the regions in the country. The preparation of "kenkey" is tedious and time-consuming and most consumers prefer buying it from market-places to preparing it themselves.

Information collected indicated various forms of adulteration as shown in Table 1. Apart from saccharin which is added as a sweetener, all the other adulterants were added to increase bulk and therefore the profit margin of the sellers.

Table 1 : Adulteration of maize products in various regions

Maize product	Adulterant	Region/s
Maize dough	Cassava dough	Greater Accra
"Koko" (maize porridge)	Saccharin	Greater Accra
	Cassava starch	Greater Accra, Eastern, Volta
"Ekuegbemi" (Maize grits porridge)	Cassava starch	Greater Accra, Eastern
"Fanti Kenkey"	Cassava dough	Central, Western, Eastern.
"Ashanti Kenkey"	Cassava dough	Ashanti
"Esikyere dokon" (Sweet kenkey)	Saccharin	Brong-Ahafo
"Abolo" (baked) (Baked maize tarts)	Plantain flour	Brong-Ahafo

(ii) Rice

Rice is consumed to a large extent in the country usually as the whole grain. Several dishes are prepared from it. Some of them were named by informants as usually adulterated.

"Yellow rice" or "buttered rice" is rice cooked in margarine or butter to give it a cream or yellow colour in addition to flavour. In parts of the Greater Accra, Eastern, Ashanti and Central regions, yellow colouring was reported to be partially or wholly used in place of either butter or margarine.

"Jollof rice" is rice cooked in spiced tomato juice or sauce until all the liquid is absorbed and the rice becomes soft and attains a reddish-orange colour. This food was reported to be adulterated with either red or orange colouring or the ground seeds of Bixa orellana locally called "tomato powder" thereby cutting down on the amount of ingredients especially tomatoes used but at the same time giving the consumer a false impression that the correct amount has been used. It is relevant to note here that, a large section of the Ghanaian public considers foods such as stews, sauces, soups and "Jollof rice" with the bright red or orange colour as being of superior quality. These colours are normally attained through the use of ripe tomatoes, canned tomato puree or paste or even red peppers. Adulteration of "Jollof rice" was reported in most of the regional capitals namely Accra (Greater Accra), Cape Coast and Winneba (Central), Koforidua (Eastern), Ho (Volta) and Kumasi (Ashanti).

"Rice and beans" (waakye) is rice boiled with cowpeas (Vigna unguiculata) in salted water together until soft and cooked. A reddish or purplish brown colour is associated with this food and is normally achieved when the red variety of cowpeas is used. When the white variety is used, the desired colour is attained through the incorporation of dried sorghum (Sorghum caudatum) leaf sheaths and stems during the cooking period. The possible natural contaminants in this plant are discussed in section 4.4.1. Sorghum stems are used in cooking "rice and beans" in all the eight regions visited.

"Omo-tuo" (cooked rice balls) is rice meal cooked into a soft dough with salted water after which it is moulded into balls. According to several informants, rice flour is sometimes adulterated with maize flour before being used for "omo-tuo" in parts of the Greater Accra, Ashanti and Northern regions.

In Sunyani, the Brong-Ahafo regional capital however, rice flour was reported to be adulterated with maize dough. The purpose for adulteration is to increase bulk and therefore profit since maize is a cheaper commodity than rice.

(iii)Millet

Millet is cultivated in the northern sector of the country. It is put to a variety of uses such as the preparation of "Hausa koko" "Fula", and "Burukutu" (a locally prepared alcoholic beverage). These were named by some informants as normally adulterated in some regions.

"Hausa Koko" is spiced porridge made from either millet or sorghum flour. Normally red peppers and other spices are used to give the porridge a light reddish brown colour. In Accra and Koforidua, the writer was informed of the use of dried sorghum stems to provide colour to the porridge thereby reducing the amount of spices used.

"Fula" is millet flour compressed, shaped into balls and boiled. The cooked balls are broken and mixed with water and ground spices before eating. In the cattle-rearing areas, fresh milk is used in place of water. From the information gathered, millet flour is sometimes adulterated with ground rice in parts of Accra before being used in preparing the "fula".

(iv)Wheat

Wheat is not grown in the country but is imported and milled in local flour mills located at Tema in the Greater Accra region and Takoradi in the Western region. In addition, various types of wheat flour are imported into the country under the Government's Trade Liberalization Policy.

Wheat flour is put to a variety of uses such as for the production of bread, doughnuts, cakes and biscuits. Locally-produced flour is usually packaged in 50 kilogramme weight bags and occasionally in five kilogramme retail packs. In most markets in the country however, wheat

flour is sold unpackaged in bowls from where it is retailed by volume using semi-conventional measuring cans. It is observed that this practice renders the commodity susceptible to adulteration in the markets.

Wheat flour on sale in markets in the Volta, Central, Eastern, Western, and Greater Accra regions was reported to be adulterated with either maize flour or cassava flour locally called "kokonte". The markets involved were the Ho Central market (Volta), Cape Coast market (Central), Koforidua market (Eastern), Sekondi market (Western) and the Makola market in the Greater Accra region. According to other informants in Accra, after adulteration with the commodities mentioned, potassium bromate is added to the mixture to improve its leavening properties. The author wishes to recall a recent publication in a Ghanaian daily newspaper (The Ghanaian Times of 19th July 1989) which drew the public's attention to an announcement made jointly by the Ghana Standards Board and the local flour mills regarding the adulteration of flour with potassium bromate by some bakers in the country.

More informants in the Greater Accra region reported that locally-produced wheat flour is sometimes adulterated with other types of wheat flour imported from neighbouring countries under the Trade Liberalization Policy. According to them, the imported types are of inferior quality and only suitable for pastries. It is likely these flours are produced from "soft wheat".

Products from wheat flour namely sugar bread and a type of doughnuts locally called "togbei" were named as being adulterated with saccharin instead of using sugar. This form of adulteration was recorded in the Greater Accra, Eastern and Ashanti regions. At Sunyani in the Brong-Ahafo region, the author was informed that yellow or sometimes pink colouring was added to "togbei" in addition to saccharin.

The Catholic Relief Services donates "wheat-soy-Blend" to be used as a feeding supplement for malnourished children. This product is offered free of charge to mothers and guardians of such children. In three of the regions visited, I was informed that not only does this product find its way into the markets where it is sold but it is also adulterated with cassava flour (kokonte) before being sold. The regions involved were Greater Accra, Ashanti and Brong-Ahafo.

3.2.2 Root Crops and their products

(i) Cassava

Cassava is a common rootcrop in the country and is consumed by a large section of the population. Despite this, only few reports of adulteration were made. In my opinion this may be attributed to the fact that it is abundant throughout the year and grown well in most types of soils.

"Cassava fufu" is boiled cassava pounded into a paste which is eaten with soup. This food item is sometimes pounded with boiled unripe plantain giving the final product a cream or light yellow colour which is preferred by consumers. According to some informants in the Eastern and Ashanti regions, some "chop bar" (restaurant which serves traditional dishes) operators in these regions pound the boiled cassava with a little palm oil instead of plantain thus deceiving the consumer by giving him a wrong impression.

Some informants in the Volta region also disclosed that the dried leaves or the bark of a particular tree are sometimes boiled with the cassava and these impart a colour characteristic of cassava mixed with plantain fufu. Once again the consumer is cheated through visual deception. The informants were however unable to name the plant.

3.2.3 Grain Legumes

(i) Groundnuts/Peanuts

Groundnuts are an important grain legume in Ghana and are cultivated mainly in the northern and southern savannah zones. The nuts may be roasted or boiled and consumed as such or used in preparing several traditional dishes.

Groundnut soup is very popular throughout the country. The nuts are roasted, peeled and milled or sometimes pounded into a smooth paste which is used as spread and also in preparing soup. Pounding the nuts is a tedious process and most people who cannot afford domestic mills prefer to buy the already-made paste from the markets. In the Brong-Ahafo and Northern regions, oil is extracted from the paste by adding water and kneading. The residue after oil extraction locally called "tunkusa" is rolled out dried and fried to produce a snack called "kulikuli".

Groundnut paste sold in the markets was one commodity named by several informants in all the regions as adulterated with various food items.

In Greater Accra, Central, Western and Volta regions, groundnut paste on sale in the markets is adulterated with either maize flour, roasted maize meal or cassava flour. In addition, informants named dried and ground avocado pear seed as another adulterant for groundnut paste in the Greater Accra region.

In the Eastern region, cassava flour, roasted maize meal and dried and ground pear seed were named by most informants. According to the informants, during adulteration, some cooking oil preferably groundnut oil or soya bean oil is added to give the product the desired consistency to avoid detection by the purchaser.

Another adulterant named in the Eastern region was the fruit of the plant, Artocarpus altilis popularly called "Breadfruit" in the country. This fruit according to informants is fried and milled into a powder before being added to the groundnut paste.

Information collected in the Ashanti region revealed that cassava flour, water and fresh cassava chips are the popular adulterants for groundnut paste. According to the informants, fresh cassava chips are added to the roasted and peeled groundnuts after which they are milled together. With water, this is added to the paste and the mixture beaten or creamed to give an even consistency as well as to incorporate air thereby increasing the bulk and therefore the profit margin.

In the Brong-Ahafo region, only cassava flour was named whilst informants in the Northern region named maize flour and "tunkusa" as adulterants for groundnut paste.

It is worth stating that most food items including groundnut paste are sold by volume and not weight in markets in the country.

(ii) "Agushie" (Seeds of Cucumeropsis edulis)

The seeds of the plant Cucumeropsis edulis are locally called "Agushie" and used in preparing soups and stews (agushie, kontomire) in the country. The seeds are usually ground into a smooth paste before being used. As with groundnuts, this is tedious and time-consuming and most consumers prefer to buy milled "agushie" sold in the markets. This food item was named as normally adulterated in five regions in the country.

Several informants in the Greater Accra, Central and Western regions named maize flour, wheat flour and "gari" (fermented and fried cassava dough) as the popular adulterants for agushie. In addition to these, informants in the Eastern region named milled fresh groundnuts and fried and milled "breadfruit". In the Northern region, only two adulterants were named.

These were maize flour and milled fresh groundnuts.

(iii) African locust bean (Parkia clappertoniana)

In parts of the country especially the northern sector, the seeds of the plant Parkia clappertoniana are fermented into a product locally called "dawadawa" which is used as a food condiment. This product according to informants in the Northern region is sometimes adulterated with either "tunkusa"(groundnut residue after oil extraction) or boiled groundnuts which are pounded with the fermented product before it is offered for sale.

3.2.4 Fruits and vegetables

(i) Tomatoes

Tomatoes are mainly cultivated in parts of the Accra plains and parts of the Brong-Ahafo region. The production of tomatoes and other vegetables fluctuates a great deal during the year. There is always a period of glut with low prices followed by a long period of scarcity and high prices. As stated in section 3.2.1 (ii), most Ghanaians have a preference for soups and stews with bright red or orange colours which are usually attained through the use of large quantities of tomatoes, both fresh and canned as well as red peppers.

In most homes, fresh tomatoes are ground into a smooth paste on a grinding stone before being used in soups and stews. In others especially these in the urban areas, domestic blenders are used. In most major markets however, mills have been installed for grinding vegetables and other condiments used in preparing soups and stews. These mills are patronised by "chop-bar" operators. This created another opportunity for adulteration in some of the regions visited.

Information collected from the Volta, Eastern, Central and Greater Accra regions showed that some "chop bar" operators and food hawkers during the milling process add the seeds of the plant Bixa orellana to the tomatoes to enhance the red colour of the final product. By so doing they reduce the amount of tomatoes used and thereby cut down on cost. According to the informants, this practice is rampant during the dry season when fresh tomatoes are scarce and expensive.

(ii) Pepper (Capsicum sp.)

Pepper is sold in the markets in the fresh, dried, and milled forms. Due to the labour involved in grinding this commodity before use, most people prefer to buy the milled pepper. Unfortunately however, the commodity in this form was reported to be adulterated in seven of the eight regions visited. The popular adulterants used were the dried and milled seed of the Avocado pear, milled poor grade or discarded kola-nuts (Cola acuminata) and the milled seeds of the Bixa plant.

In the Greater Accra and Eastern regions, all the three adulterants were named by informants. According to them, pear seeds or kola-nuts are cut into small pieces, dried and milled together with the dried pepper. The dried Bixa seeds because of their size are added whole and milled with the pepper. In the Central and Western regions, kola-nuts and Bixa seeds are used whilst kola-nuts and pear seeds were named in the Ashanti and Brong-Ahafo regions. In the Volta region, information collected showed pear and Bixa seeds as the adulterants for ground pepper. No report of adulteration of the commodity was recorded in the Northern region.

The naturally-occuring contaminants present in kola-nuts are mentioned in Sections 4.4.2 and 4.4.4. The author was unable to get any information regarding the toxic constituents of the pear and Bixa seeds. Lecturers at the Biochemistry departments of both the Universities of Ghana and of Science and Technology however showed keen interest in these two adulterants and expressed their disposition to research into them.

(iii) Okro

The immature fruit pods of Hibiscus esculentus which are very mucilaginous are used for soups and sometimes in combination with native garden-eggs (Solanum sp.) for stews. Like other vegetables grown in the country, they are seasonal. Traditionally,okro are preserved by sundrying. Whole dried pods and sometimes coarsely pounded pods are sold in the markets. Adulteration of ground okro was recorded in the Makola and Nima markets both in the Greater Accra region and the Kumasi Central market in the Ashanti region. The only adulterant named by all informants was wood-ash.

The leaves of the Bush Okro plant (Carchorus olitanius) are sometimes used in soups. During the dry season, they are sold in the powdered form in the markets. According to informants in the Greater Accra region, the powdered leaves are adulterated with leaves of various plants. These include cassava (Manihot utilissima), cowpea (Vigna unguiculata), and silk cotton (Ceiba pentandra) plants.

3.2.5 Meat, poultry, fish and other seafoods

(i) Meat

In the country,various livestock are slaughtered for their meat. These include cattle, sheep, goats and pigs. Other sources of meat include the Grasscutter (Thryonomis swinderianus) and the Bushbuck (Tragelaphus Scriptus Pallas). The country is not self sufficient in

meat production and some is imported to augment local supplies. A large proportion of the country's meat is sold in the local markets and the rest in few government and privately-owned shops. Most markets do not have refrigeration or freezing facilities and meat is exposed to the sunshine, flies, dust and micro-organisms. Meat on sale in most markets is therefore subject to rapid deterioration.

Some informants in the Eastern region revealed that raw beef offered for sale in the Koforidua market is sometimes sprinkled with or even soaked in water which has been coloured red to give the meat a fresh appearance. The use of red colouring was again recorded in the Central and Greater Accra regions where it is used to dye salted beef and pigs'feet (trotters) which are delicacies in some soups.

Pieces of meat are sometimes seasoned, skewed on sticks then coated with a mixture of ingredients such as "kulikuli" (groundnut residue after oil extraction) and ground pepper. The meat is then grilled on open fires into "Khebab". According to informants, grass-cutter meat is in addition coated with the ground seeds of the Bixa plant before grilling, in parts of the Central region specifically Winneba and its surrounding areas. In the Greater Accra region, Bixa seeds are used on pork khebab instead.

(ii) Poultry

The use of the ground Bixa seeds was again recorded in the Greater Accra region especially in Osu and Labadi. Turkey tails are fried and sold along several streets in these areas. These turkey tails are seasoned then coated with the ground Bixa seeds before frying to give the product an attractive colour.

(iii) Fish

The country's marine fisheries stretch along the entire coastline and the fishing industry assumes its peak importance during the period July to early October. Fish being a highly perishable commodity has to be preserved as soon as it is caught. In the country, deep sea motor vessels are equipped with freezing facilities, however, canoes and some in-shore motor vessels do not possess freezing or icing facilities. By the time these vessels land their catch, deterioration has started. Some of the fish is sold in the "fresh" state whilst the rest is either frozen, sundried, smoked, salted, or fried.

According to a number of informants in Accra markets, in an attempt to conceal the deteriorated state of the fish, some sellers resort to dyeing the gills of such fish with red dyes to deceive prospective buyers about the actual quality of the commodity. Other sellers soak fish in water which has been coloured red before displaying them for sale.

(iv) Shrimps

Smoked shrimps are sold in markets in the southern half of the country where they are used as a condiment to flavour soups and stews. Although some is imported from neighbouring countries, a greater proportion is smoked locally along the coast in the Volta region.

Smoked shrimps with a golden-brown colour are considered to be of the best quality and attract the highest price. In the Volta region, this colour is obtained during smoking when dried sugar-cane chaff (bagasse) or a special type of grass (Paspalum vaginatum) locally called "Soli" is used.

Information collected in the Greater Accra region showed that some processors in the region soak the fresh shrimps in water which has been coloured with orange dye for a period of time before smoking to attain the golden-orange colour desired by consumers

3.2.6 Eggs and dairy products

Only two instances of adulteration were reported for foods in this grouping. At Sunyani in the Brong-Ahafo region, two informants reported that eggs are sometimes adulterated with water before whisking to fry. By so doing, three fried pieces are obtained and sold as three eggs from just two. According to one informant in the Central region, eggs are sometimes whisked with yellow colouring before frying to create an impression of richness to the consumer.

3.2.7 Fats and Oils

Fats and Oils are used for the daily preparation of food in most parts of the country. Some of these oils are imported whilst others are locally prepared by traditional methods. The locally produced ones include palmoil and "dzomi" both produced from the pericarp of the fruits of the African oil palm (Elaeis guineensis), and palm-kernel oil which is produced from the kernels of the fruit of the same plant. Other locally produced oils are groundnut oil, cocoonut oil and shea butter which is produced from the seeds of the plant Buty rospermum parkii.

Palmoil is more common in the country than "dzomi" and has a lower price because unlike the latter, the nuts used need not be very fresh and can be three or more days old. "Dzomi" is regarded as a special oil because of its exceptionally pleasant scent and taste due to the fact that very fresh nuts are used and the product is flavoured with onions, ginger, salt and other spices. Groundnut oil is also more expensive than palm-kernel and coconut oils because of the relative higher cost of groundnuts.

Locally-produced cooking oils are sold in large bowls by volume in the markets by using specific "measuring bottles". The purchaser normally carries his own bottle or container into which the oil is poured after measuring. Imported cooking oils are however usually sold in their sealed containers although sometimes they are also retailed by using smaller measures.

The Ghana Standards Board has prepared standards for all these locally-produced fats and oils (2). These standards state specifically that these fats and oils shall be free from admixtures with other fats and oils. Information gathered however, showed that these oils are sometimes adulterated with cheaper ones before being offered for sale in some markets. Table 2 shows the various forms of adulteration of oils in some regions in the country.

Table 2: Adulteration of oils in various regions

Oil type	Adulterant	Region/s
Soyabean oil (imported)	Groundnut oil, Coconut oil	Greater Accra, Central, Western
"Dzomi"	Palm-oil	Greater Accra, Volta, Eastern
Palm-oil	Palm-kernel oil	Ashanti
Groundnut oil	Coconut oil	Greater Accra, Western

3.2.8 Alcoholic and non-alcoholic beverages

(i) Palm-wine

Palm-wine is the fermented sap of either Elaeis guineensis or Hyphaene thebaisa. It is a traditional alcoholic beverage enjoyed in both rural and urban areas. It is also used for the production of raw alcohol locally called "akpeteshie".

When tapped initially palm-wine contains about 13% sucrose but soon after, yeast spores especially those of Saccharomyces cerevisiae infect the juice and start the fermentation of the fermentable sugars. This alcoholic beverage was found to be normally adulterated in seven out of the eight regions visited. No adulteration was reported in the Northern region where the beverage is hardly produced or consumed.

The most common adulterant named was water which is used to increase the bulk but which results in the dilution of the drink. To make up for the resultant reduced sweetness, sugar, saccharin, or the fruits of the plant Synsepalum dulcificum (Miraculous berry) locally called "Asao" are added. According to informants in one regio the flavour enhancer monosodium glutamate (MSG) is added after adulteration with water. In other regions, yeast, baking soda and saltpetre locally called "kawe" are added to increase the foaming properties of the drink after adulteration with water. According to other informants, tobacco leaves are sometimes added to increase the potency of the drink. The various adulterants of palmwine in the regions are shown in Table 3

Table 3 : Adulteration of palm-wine in the various regions of Ghana

Adulterant/s	Region/s where recorded
Water and sugar	Ashanti, Brong-Ahafo, Greater Accra, Eastern, Central, Volta, Western.
Water and saltpetre	Ashanti, Greater Accra, Eastern, Volta
Water and "Asao"	Greater Accra, Volta
Water and monosodium glutamate; water and saccharin.	Greater Accra
Water and yeast	Ashanti
Water and baking soda; dried tobacco leaves	Eastern

(ii) "Akpeteshie" (locally distilled alcohol)

This alcoholic beverage is distilled from either palm-wine sugarcane or pineapple.

Several adulterants were named for this beverage, the most popular one being boiled water which is added to increase the amount of drink and therefore the seller's profit margin. Water as an adulterant was named by informants in all the eight regions visited. According to them the water has to be boiled before adding to prevent easy detection by the consumer. In addition to water, other adulterants were named as added to increase the stimulant effect of the drink.

In the Greater Accra region, informants named dried tobacco leaves, soda water (carbonated water), marijuana (cannabis), rusty nails and a laundry detergent (Omo) as the adulterants used to increase the stimulant effect. Informants in the Ashanti region named nails and fresh neemtree leaves as adulterants used in addition to boiled water.

The author visited an "akpeteshie" production plant at, Pokuase on the outskirts of Accra. According to the distillers none of the above adulterants are added to the beverage during production. They however did not rule out the possibility of adulteration by retailers of the drink. Production of the drink was in progress at the time of visiting the plant and although there were no signs of adulteration, the conditions under which production is carried out are likely to lead to contamination of the final product. This is further discussed in Section 4.2.1. (v).

(iii) "Pito"

Pito is an alcoholic beverage brewed from sorghum or millet. It is consumed mainly in the northern sector of the country.

Adulteration of this beverage was recorded in only three regions. These are the Brong-Ahafo and Ashanti regions where marijuana leaves and seeds were reported to be added during the brewing process to increase the stimulant effect of the final product. In this connection, particular mention was made of "pito" brewed in Ejura in the Ashanti region. In the Northern region, dried tobacco and marijuana leaves were named by informants.

(iv) Ice-lollies

Ice-lollies are made by just dissolving dye or colour in water. Sugar is added and the coloured sugar solution is frozen. These were made and sold mostly by young people in most urban cities and towns visited. According to some of the vendors, the dyes and colours used are bought from the markets and these are added to water till the required shade of colour is obtained. These dyes are therefore used without any proper measurements and thus it is possible that the levels at which these colours are allowed are easily exceeded by these users.

3.2.9 Soups and stews

Several local restaurants popular known as "chop bars" which serve traditional dishes are present in many urban cities and towns in the country and are patronised mainly by low-income earning workers. Information collected revealed that some soups and stews prepared and served at these places are adulterated in one form or another.

Palmnut soup was reported to be adulterated with ripe plantain or cassava to help mask the rancid taste of the soup when poor grade or mouldy palm-nuts are used. The boiled nuts are pounded with the ripe plantain or a piece of cassava and the mixture mashed with water and strained to prepare the soup. This form of adulteration was reported in the Greater Accra and Brong-Ahafo regions.

Groundnut soup was also reported to be adulterated with maize flour in parts of the Western and Eastern regions and with cassava flour (kokonte) in the Brong-Ahafo region. According to the informants, the amount of groundnut paste used determines the thickness of the soup. These cooks use less groundnut paste to cut down on cost, and to attain the thickness desired by consumers, they resort to the use of flours.

Okro soup was reported to be adulterated with wood-ash in parts of Greater Accra and Northern regions. Normally saltpetre is added to this soup during cooking to help soften the pieces of chopped okro and to make the soup more mucilaginous. According to informants in the two regions, to cut down cost some cooks use wood-ash instead of saltpetre.

In parts of the Ashanti and Greater Accra regions, stews and sauces were reported to be adulterated with the ground seeds of the Bixa plant to obtain the bright red or orange colour associated with these foods and desired by consumers.

Several consumers interviewed in all the regions expressed concern about the rampant and excessive use of the flavour enhancer, mono-sodium glutamate in most soups, stews and other "Ready-to-eat" foods in their regions.

3.2.10 Miscellaneous foods

(i) Sugar

Granulated sugar is retailed by volume in several markets. Some informants in the Greater Accra region revealed that some sellers of this commodity sprinkle water on it causing it to swell and thereby increasing their profit margin.

(ii) Honey

Honey was reported to be adulterated with caramel in parts of the Greater Accra region before being offered for sale.

(iii) Baking Powder

Baking powder is sometimes retailed in polyethylene bags. Informants in the Makola market in Accra disclosed that the commodity sold in this form is sometimes adulterated with wheat flour or granulated salt.

(iv) Curry Powder

Curry Powder, sometimes retailed in polyethylene bags was reported to be adulterated with maize flour in some markets in the Greater Accra region.

3.3 Tabulated summary of major findings regarding food adulteration

Commodity/product	Adulterant/s	Region/s where adulteration recorded
Cereal and cereal products		
Maize dough	Cassava dough	G-A
Maize porridge (koko)	Saccharin, cassava starch	G-A, E, V
Maize grit porridge (ekuegbemi)	Cassava starch	G-A, E.
Cooked maize dough (kenkey)	Cassava dough, saccharin	C,W,E,A,B-A
"Yellow rice"	Yellow colouring	G-A, E,A,C
"Jollof rice"	Orange or yellow colouring, seeds of Bixa plant	G-A,C,W,E,V,A
"Rice and beans" (waakye)	Dried sorghum stems	G-A,C,W,E,V,A,B-A,N
Rice balls (Omo-tuo)	Maize flour, maize dough	G-A, A, N, B-A
Millet porridge (Hausa koko)	Dried sorghum stems	G-A, E
Millet balls (Fula)	Ground rice	G-A
Wheat flour	Maize flour, cassava flour, potassium bromate	V,C,E,W,G-A
Doughnuts (Togbei)	Saccharin, yellow and pink colourings	G-A,E,A,B-A
Sugar-bread	Saccharin	G-A,E,A
Root crops and products		
Cassava fufu	Palmoil, dried leaves and bark of a tree	E,A,V,
Grain legumes		
Groundnut paste	Maize flour, roasted maize meal, cassava flour, dried and ground avocado pear seed, cooking oil, Breadfruit, water, fresh cassava chips, groundnut residue (Tunkusa)	G-A,C,W,V,E,N,A,B-A
Ground "agushie" (Cucumeropsis edulis seeds)	Maize flour, wheat flour, milled groundnuts, breadfruit	G-A,C,W,E,N

Commodity/product	Adulterant/s	Region/s where adulteration recorded
Fermented locust bean (Dawadawa)	Groundnut paste, groundnut residue (tunkusa)	N
Fruits and vegetables		
Ground tomatoes	Seeds of Bixa orellana	V,E,G-A,C
Pepper powder	Avocado pear seed, kolanut, seeds of Bixa plant	G-A,E,C,W,A, B-A,V
Okro powder	Woodash	G-A, A
Dried okro leaves	Cassava leaves, silk cotton tree leaves, leaves of cowpea plant	G-A
Meat, poultry, fish and other sea foods		
Grilled meat(khebab)	Seeds of Bixa plant	C,G-A
Fried turkey tails	" "	G-A
"Fresh" fish	Red colouring	G-A
Smoked shrimps	Orange colouring	G-A
Eggs and dairy products		
Fried eggs	Water, yellow colouring	B-A, C
Fats and oils		
"Dzomi"	Palm-oil	G-A,V,E
Palm-oil	Palm-kernel oil	A
Coconut oil	Palm-kernel oil	G-A, A
Groundnut oil	Coconut oil	G-A, W
Soybean oil	Groundnut oil, coconut oil	G-A,C,W.
Beverages		
Palm-wine	Water, sugar, saltpetre, mono-sodium glutamate, baking soda, yeast, saccharin, tobacco leaves miraculous berry.	A,B-A, G-A,E,C,V,W

Commodity/product	Adulterant/s	Region/s where adulteration recorded
"Akpeteshie"	Water, tobacco leaves, marijuana, carbonated water, nails, detergent, leaves of neemtree	G-A,C,W,E,V,A,B-A,N
"Pito"	Marijuana, tobacco leaves	B-A, A,N
Ice-lollies	Yellow,orange,red, green colouring	G-A,W,C,E,V,A,B-A
Soups and stews		
Palmnut soup	Plantain, cassava	G-A,B-A
Groundnut soup	Maize flour, cassava flour,	W,E,B-A
Okro soup	Wood-ash	G-A, N
Various stews	Seeds of Bixa plant	G-A, A
Miscellaneous foods		
Sugar	Water	G-A
Honey	Caramel	G-A
Baking powder	Wheat flour, granulated salt	G-A
Curry Powder	Maize flour	G-A

KEY TO TABLE

Code	Region
G-A	Greater Accra
E	Eastern
C	Central
W	Western
V	Volta
A	Ashanti
N	Northern
B-A	Brong-Ahafo

4. ACTIVITIES AND MAJOR FINDINGS REGARDING FOOD CONTAMINATION

4.1 **General Observations**

4.2 Contamination resulting from the inadequate and unsatisfactory processing and handling of food

4.2.1 Inadequate and unsatisfactory processing practices

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4.4.7 Some other naturally-occurring toxicants

4.5 Environmental or industrial pollution

4.5.1 Effluents from industry

4.5.2 Other forms of environmental pollution.

4. ACTIVITIES AND MAJOR FINDINGS REGARDING FOOD CONTAMINATION

4.1 General observations

During the course of this assignment, it became evident, that limited research work has been done and documented on food contamination in the country. Apart from few published papers, the rest consisted of student project reports in the country's universities. From discussions, the major constraint identified was the lack of appropriate equipment in the country's research institutions, universities and other establishments for the analysis of contaminants such as the pesticide residues, heavy metals and fungal toxins.

Regarding contamination resulting through inadequate and unsatisfactory processing and handling of food, visits were made to several markets and traditional food processing sites in the country. The levels of personal hygiene and general sanitation were generally low. It is to be noted that large and small-scale food manufacturers in the country are required to have their products tested and certified by the Ghana Standards Board before they are offered for sale. These certificates are renewed yearly for large industries and every six months for the small ones. On-the-spot checks are also conducted at the factories from time to time. These checks are however not carried out for the traditional small-scale food processors and this may have contributed to the unhygienic conditions and improper processing practices prevailing at these plants. Another general observation made was that the handling, processing and utilization of food at the traditional level is dominated by women most of them though highly enterprising are illiterate or have not had any formal education.

The country currently has no laws governing the disposal of industrial wastes into water bodies, and information gathered revealed that there may be localised water pollution occurring in some parts of the country especially in the mining areas and some urban towns. There is therefore the need for monitoring as well as the establishment of anti-pollution laws.

4.2 Contamination resulting from the inadequate and unsatisfactory processing and handling of food

4.2.1 Inadequate or unsatisfactory processing practices

(i) Traditional processing of cassava into flour (kokonte)

In the country availability of local foodstuffs is seasonal and most food items are sometimes partially processed prior to selling. Fresh cassava is sometimes processed into flour locally called "kokonte". The cassava tubers are peeled, cut into chips and sundried after which they are milled into a fine powder.

The author during her trips to the Volta and Eastern regions observed that cassava chips were spread out either on the ground, roof tops or on mats, by the roadsides to dry. This practice was observed in towns such as Kpone, Prampram, Aburi, and Mampong. When chips are dried this way, they are likely to be contaminated with dust from the environment or droppings and urine from rodents, lizards, birds and insects.

During food processing, it is important that proper hygienic practices are utilized to prevent microbiological contamination which can sometimes lead to outbreaks of food-borne diseases. Cassava chips need to be protected from the sources of contamination named above. In this connection, the use of locally-manufactured solar driers should be encouraged. The Food Research Institute has designed and constructed various types of solar driers some of which can be used to dry cassava chips and vegetables such as okro, pepper and onions under hygienic conditions (3). The use of such driers should be encouraged in both rural and urban areas.

(ii) Processing of cattle hide (wele)

Processed cattle hide (wele) is sold in local markets as a meat product. It is consumed by many people throughout the country in soups and stews.

The author visited one major location in Accra (near the banks of the Korle lagoon) where processing of the product is carried out. Initially the raw hides are singed using naked fires. Fuel material in use were worn-out tyres and scraps from tyres. These according to some of the processors are obtained from local tyre and footwear factories and are a cheaper fuel source than conventional firewood.

During the burning and singeing process, thick black smoke is produced, a sign of incomplete combustion of the tyres. This is associated with the evolution of carbon monoxide, sulphur dioxide and a whole chain of hydrocarbon compounds. It is also documented that the hydrocarbon fraction of wood smoke carry some toxic components, the best known being the poly-aromatic hydrocarbon groups like pyrene and its derivatives 1, 2 and 3, 4-benzopyrene which have been implicated as suspect cancer agents.

It is to be noted that during singeing the hides may be subjected to some of these toxic smoke components evolving from the burning tyre. These could be absorbed into the tissues of hide and pose a threat to the health of the consumer. The use of scrap rubber tyres as a fuel source is therefore unacceptable and the practice should be discouraged.

(iii) Traditional processing of oil-palm

The author visited a traditional oil-palm processing plant at Achimota a suburb of Accra and had informal discussions with the processors who were all women. According to them, for the preparation of palm-oil, the palm-nuts which may be two or three days old are sprinkled with water then covered with polyethylene to enable heat to be generated. This heat swells the pulp around the nuts which are then pounded in a large comented structure about six feet in diameter and six inches deep. According to the processors, pounding is done using the feet.

Pounding of palm-nuts with the feet is certainly a source of contamination and from the aesthetic point of view unacceptable. In an earlier discussion with the Greater Accra Regional organiser of the 31st December Women's Movement, Miss Zormelo, I was informed that her organisation and others such as the National Council for Women and Development and National Board for Small-scale industries have been organising traditional processors (including food) into co-operatives to be able to purchase small-scale processing equipment such as the palm-oil extractor to help up-grade some of the traditional processing practices which are very tedious and likely to lead to contamination of the final product.

(iv) Traditional fish processing

At Keta and its surrounding villages in the Volta region, the majority of inhabitants engage in fishing, fish processing and marketing. Fish is processed by smoking, drying or frying. During discussions with some processors, it was revealed that normally some kerosine is added to the water used in rinsing the fish before sundrying to keep away flies. This practice can contribute to contamination of the product. Drying is carried out by simply spreading the fish on the sand along the beach. Apart from the adverse effects of rain on the quality, there is also the problem of contamination from exposure to dust, insects and micro-organisms from the environment.

A lot of smoked fish is consumed in the country and research needs to be carried out on the possible presence of polynuclear compounds in this commodity. The literature survey revealed one documented work which showed that locally-smoked herrings and Polo fish contained 27.1 and 13.9 ppb. of benzo (a) pyrene respectively whilst benzpyrene levels were found to range between 32.4 and 66.4 ppb. (4).

(v) Production of locally-distilled alcohol (Akpeteshie)

As stated in section 3.2.8 (ii), a visit was made to an Akpeteshie production plant at Pokuase in the Greater Accra Region. Environmental hygiene and sanitation were generally poor. The beverage was being produced under unhygienic conditions; metallic drums used for fermentation were rusted on both inside and outside, and there were signs that water used in cooling the distillate was not regularly changed. After the distillation process, the spent fermentation mixture was allowed out into a drain which though cemented contained a lot of dirt including dried leaves. This drain is blocked at one end and a portion of the spent

mixture scooped and added to a fresh fermentation mixture to begin the production of another batch.

Regarding the unhygienic practices prevailing at such production plants, simple codes of hygienic practice need to be developed, accepted and put into effect on a national level. In addition, there should be a general awareness-awakening of the consumer to refuse to tolerate insanitary conditions and practices in these traditional food establishments.

4.2.2 Contamination from processing equipment

The problem of metallic food contamination resulting from processing equipment usually occurs as a result of misuse of the equipment or the overlooking of the consequences of using unsuitable metals in the manufacture of food processing equipment.

In the country, foreign exchange constraints have served as a stimulating factor in the development of the local metal fabricating industry. Several pieces of equipment such as baking and frying pans, sieves, aluminium pots and pans, drum ovens, ladles, handgraters and knives are produced by indigenous entrepreneurs.

According to informants at one of the manufacturing sites in Accra, metal scraps and discarded vehicle body parts are used in the manufacture of these pieces of equipment. Some of the metal pieces in use for the manufacture of pans for frying doughnuts and plantain on a semi-commercial scale were observed to be rusty and would certainly be a source of contamination to the food.

Much as the ingenuity of these local manufacturers must be commended, sight must not be lost of the possible dangers their equipment could pose to the health of the consumer.

4.2.3 Packaging materials as sources of contaminants

It is known that a major source of food contamination is the packaging material from which monomers, additives or residual solvents in the case of printed plastic or aluminium films, may migrate into the food (5).

In Ghana, foods are packaged in metal and glass containers, polyethylene, paper and traditional packaging materials such as the leaves of various plants.

Not much research has been done regarding food contamination resulting from packaging material. This subject was discussed with the Head of the Food and Agriculture department of the Ghana Standards Board, Mr. Yankey. The author was informed of the establishment of a committee to address the problem. This committee is currently working on the suitability of various packaging materials for different commodities.

Traditional packaging materials used in the country most often reflect on the environment and the cultural practices of the people. The most widely used ones are the leaves of various plants. These include Musa paradisiaca (plantain), Musa sapientum (banana), Maranthocloa purpurea, Megaphrynium macrostachyum, Sterculia tragacantha, Baphia nitida, Manihot utilissima (cassava) and sheath of Zeamays. Mostly the leaves of these plants are used in packaging various products made from maize, rice and other cereals. With the knowledge that some plants contain naturally occurring contaminants, there is the possibility that foods wrapped in, and more especially those cooked with the wrappers can get contaminated.

Infact, some local foods such as "Fanti kenkey" "Agidi" and "Egblen", all fermented corn dough products packaged in leaves are known to acquire various colours and flavours from the leaves. "Fanti kenkey" wrapped in plantain leaves attains a deep gray colour after cooking or a dark green appearance when leaves of Sterculia trangacantha are used. This point came up during discussions with the Head of the Biochemistry Department of the University of Ghana, Dr. Addy. According to her, there have been reports of some people experiencing palpitations when eating "Fanti kenkey" which according to her, could be due to contamination of the product by some components of the leaves. Research is currently being conducted at the department to determine the toxic components present in plantain leaves.

The author during the assignment, observed various types of newsprint, newspaper and even paper which had been used in packaging building cement being used in the markets and by hawkers in all the regions for wrapping food sometimes even cooked foods. These included doughnuts, bread, fried or roasted plantain, roasted groundnuts, "kenkey" and other high-moisture and oily foods. It has been documented that printed paper wrappings have been found to contain more than 50mg/kg. lead. Furthermore, letter-press magazine ink may contain 29,000mg/kg lead in yellow and 4,100mg/kg in red print (6).

The use of any available type of paper for wrapping food especially cooked and "Ready-to-eat" food bringing it into possible direct contact with toxic materials should be discouraged.

4.2.4 Improper handling of food

Foods are contaminated with microorganisms in natural conditions and can be further contaminated through inexpert handling, use of unclean utensils and from the surroundings. It is therefore of importance that

manufacturers, traders, wholesalers, retailers, caterers and other food handlers have a knowledge about the products they handle. In addition, they need to maintain high levels of personal hygiene and have a general idea about the maintenance of good sanitary practices especially at market places.

In every region visited, the level of food hygiene observed was generally low. Most food sellers in an attempt to attract customers exposed their food items in open trays in the market and by the roadsides thus rendering them susceptible to contamination by flies, dust and exhaust fumes from motor vehicles.

Discussions with the Brong-Ahafo Regional Health Superintendent, Mr. Marfo revealed that food handlers in the region especially "chop-bar" operators have been advised to maintain high levels of hygiene. Sellers of some specific food items such as fish, meat, bread, and doughnuts have been instructed to display their wares in fly-screened containers. Mr. Marfo noted that conditions prevailing at most slaughter houses in the region are not up to required standards. Although meat is inspected both before and after slaughtering, some slaughter houses in the region do not have regular supplies of pipe-borne water and sometimes resort to the use of water obtained from ponds and streams.

The author observed meat carcasses being transported from the slaughter-houses to the Makola and Mallam-Atta markets both in the Greater Accra region. Unwrapped carcasses were simply placed in the booths of vehicles to be transported to the market sites where they are removed and carried by men on their bare shoulders into the stalls. These practices certainly expose the meat to various forms of contamination, and better methods of transporting meat need to be used.

At the Kumasi Central Market and Asafo Markets both in the Ashanti region, the situation regarding food hygiene was similar to what has been earlier described. The author was informed by the Ashanti Regional Environmental Health Technologist, Miss Sakyi about the existence of Bye-laws on Sanitation and Health. These laws have sections on the Control of Hawking, Slaughter-houses, Food Hygiene and General Sanitation amongst others. Infact these laws exist for all the regions of the country. However, the food-sellers appear to have taken them for granted and are probably taking advantage of the rather relaxed attitude of the enforcement agencies in ensuring their strict compliance.

4.3 Misuse of pesticides and fertilizers

4.3.1 Visits to related Agencies

(i) Ministry of Agriculture

The author had discussions with Mr. Anamoah of the Plant Protection and Regulatory Services of this Ministry in Accra. She was informed about the establishment in the country of a National Toxic Committee responsible for the screening and importation of agro-chemicals into the country. This Committee is currently compiling a list of permitted pesticides, and importers need to obtain a clearance from the Ministry before importing agro-chemicals into the country. A reference was made to a recent case of malathion imported without the necessary clearance. The chemical was seized and destroyed. A list of pesticides so far approved by the committee is given in Table 4.

Table 4 : Partial list of permitted pesticides in Ghana and their active ingredients

Name of Chemical	Proportion of Active Ingredient - GM/A.J./LT. GM.A.J./KG
INSECTICIDES	
Actellic Dust 2%	20gm Pirimiphos methyl/kg
Cymbush 10 EC	100gm Cypermethrine/litre
Sumithion 50 EC	50% W/V Fenitrothion/litre
Perfekthion 20 EC	200gm Dimethoate/litre
Cymbush Dimethoate	37.5gm Cypermethrine + 250gm Dimethoate/litre
Diazinon 60 EC	600gm Diazinon/litre
Karate 25 EC	250gm Lambdacyhatothrine/litre
Gammexane 20 EC	200gm Gamma HHC/litre
Roxion 40 EC	400gm Dimethoate/litre
Elocron 40 SCW	400gm Dioxacarb/litre
Phostoxin	55% Aluminium Phosphite
Gammalin 20 EC	200gm Gamma HCH/litre
Unden	200gm Propoxine/Litre
Ripcord	250gm Cypermethrine/litre
Thiodan/Thionex	350gm Endosultan/litre
Evisects	500gm Thiocyclan-hydrogenoxalate
Azodrin 55%	55% monocrotophos
Karate ULV	0.8% Lambdacyhalathrine
Actellic 25EC	250gm Pirimiphos methyl/litre
NEMATICIDES	
Furadan	30gm Carbofuran/kg
RODENTICIDES	
Klerat	0.05gm Brodifacoum/kg
FUNGICIDES	
Cobox WP	350gm Copper Oxychlonde/kg
Dithane M.45	450gm Manoozeb/kg
Kocide	Copper
Perenox	Cuprous Oxide
Cocobre Sandoz	-

HERBICIDES

Atrazine 80 WP	800 gm Atrazine/kg
Gramoxone	276 gm Paraquate/litre
Gramuron	2:1 Paraquat + Diaron
Fusilade	125 gm Flugifop-P-Butyl/litre
Primextra 500 PW	200gm Atraziné + 300 gm Metolachlor/litre
Bellatar	Atrazine + Bladex
Galex 500 EC	250 gm Metobromuron + 250gm Metolachlor/litre
Garlon 2 E	240 gm Triclopyr eb ester/litre
Gesapax Combi 500 FW	250 gm Atrazine + 250 gm Ametryn/litre
Fanoprim 500 FW	214gm Atrazine + 286 Bromofonoxim/litre
Primagram 500 FW	250gm Atrazine + 250 Metolachlor/litre
Gesaprim 50 FW	500gm Atrazine/litre
Avirosan 500 EC	100 gm Dimethametryn + 400gm Piperophos/litre
Bilof 500 EC	500 gm Piperophos/litre
Erbotan 80WP	800 gm Thiazafluron/kg
Stam F.34	360 gm Dichloropropionanilde 3.4/litre
Basagram PL2	160 g Bentazone/litre + 340g. propanil/litre
Round-up	480g/litre isopropylamine salt

GROWTH REGULATORS

Ethrel	480 gm Ethephon/litre

INSECTICIDES

Dursban 4	480g. Chlorpyrifos/litre
Vydate	Oxamyl
Temik	Aldicarb

The writer was further informed about reports of indiscriminate spraying of vegetables with agro-chemicals in the Greater Accra region. Vegetable farmers have therefore been organised into groups with technical officers of the Ministry attached to offer advice and guidance to these farmers.

(ii) Ghana Standards Board

Analysis for pesticide residues and heavy metals have until recently been done qualitatively due to lack of appropriate equipment. The Board has now acquired a Flame Atomic Absorption Spectrophotometer, an Infra-red Spectrophotometer and a Gas Chromatograph. Most of the work in progress involves pesticide formulation mainly checking on the active ingredients present. Occasionally however, food samples suspected of pesticide poisoning are analysed.

(iii) Environmental Protection Council

Officials of the Council confirmed the formation of the National Toxic Committee to screen and monitor the importation of agro-chemicals into the country.

(iv) University of Ghana (Chemistry and Crop Science Departments)

The Head of the Chemistry Department, Dr. Asomaning explained that owing to lack of equipment, no research work has been carried out on pesticide residues in foods. The Department has now acquired an Atomic Absorption Spectrophotometer and a Gas Chromatograph and would soon commence a project on pollutants.

At the Crop Science department, a lecturer, Mr. Brempong-Yeboah showed much concern over the indiscriminate use of pesticides by vegetable farmers especially in the Greater Accra region.

According to him, a seminar organised for the farmers in November 1987 revealed that excessive spraying of vegetables such as cabbage and lettuce was to rid them of the pest, Plutella xylostella (Diamond-backed moth). The author was again informed about the organization of the farmers into groups to be advised by staff of the Ministry of Agriculture. The lack of appropriate equipment for the determination of pesticide residues in foods was identified as the major constraint to research work in this Department.

(v) Ghana Atomic Energy Commission (Chemistry Department)

The author visited the Chemistry department of this Institution where she was informed by the Head of Department Dr. Yeboah that work currently going on centres around determining pesticide residues bound in stored cereals using marked isotopes.

4.3.2 Instances of pesticide misuse in Ghana

(i) Greater Accra Region

According to several informants, pesticides such as Gammalin 20, Gramoxone and DDT are sometimes used for fishing in the River Odaw around Pokuase. The pesticide is mixed with sand which is poured into the river. Further downstream, other members of the group collect the dead fish for human consumption.

There were also reports about the use of Phostoxin tablets for trapping game such as the Grasscutter (Thryonomis swinderianus) on the outskirts of Accra. The use of the grasscutter as a protein source in parts of the country has been mentioned in Section 3.2.5 (i). According to the informants, Phostoxin tablets are added to urine which has been stored for about three days. The mixture is then used as bait for the animals which are attracted by the scent of urea.

When asked about the possible toxic effects on consumers, most informants were of the view that once the animal was degutted, the meat was "perfect" for human consumption and would not pose any health problems.

Documented cases of pesticide misuse in this region were not readily available. The literature survey however revealed one case. This was an outbreak of poisoning following the ingestion of "Tuosaffi" (a local meal prepared from maize and cassava) contaminated with benzene hexachloride in which three people died (7).

(ii) Central region

The use of pesticides as bait for grasscutters was reported in Winneba and the surrounding areas. Klerat(a rodenticide) and phostoxin (a fumigant) were named by most informants as those used.

(iii) Eastern region

Gramoxone and Klerat were once again named as pesticides used in trapping grasscutters in parts of this region. According to some of the informants some granules of the pesticide Klerat are hidden in corn-cobs or in cassava tubers which are then used as bait for the animals. One informant spoken to who confessed to the practice was also of the view that inspite of the poisonous nature of the pesticide, the immediate degutting of the carcass rendered the meat safe for human consumption.

In this region, Gammalin 20 and Unden were named as pesticides used in fishing along the Rivers Volta and Birim.

According to some officials of the Ministry of Agriculture (Plant Protection and Regulatory Services) in the region, despite warnings, some vegetable farmers continued to spray their crops with pesticides such as Elocron, Unden and Gammalin 20. These are persistent and tend to retain their toxicity in vegetables and other early maturing crops for more than six months and therefore not appropriate for vegetables.

This has resulted in the banning of the use of these chemicals in the region.

(iv) Ashanti Region

The author held discussions with the Regional Director for Agriculture, Mr. Kwakwa-Sarpong. He confirmed reports of misuse of pesticides by vegetable farmers especially tomato farmers in the Akumadan area and said an FAO team recently visited the region and collected samples for analysis. According to the Regional Director, a workshop was recently organised for farmers in the tomato growing districts of the region to educate them on the correct use of pesticides.

Other information collected from the region showed that pesticides such as Gammalin 20, Unden and Elocron are used on vegetables to prevent Early and Late Blight as well as Stem Borers.

The author was informed about the formation of the "Ashanti Region Agro-Chemical Retailers and Sellers Association". This Association has been supplementing the work of the staff of the Ministry of Agriculture regarding the education of farmers on the correct use of pesticides.

One informant expressed concern about the way Phostoxin is sold openly even at lorry stations in the region. According to him some people use it domestically for killing mice and rats. Being a fumigant and available as a tablet, its domestic use for killing such pests exposes inhabitants of the house to risk. Another point raised was the misapplication of Phostoxin. Instead of the prescribed one tablet to store three "maxi bags" (150kg) of maize, some small-scale farmers tend to use the the whole tablet for lower weights of produce. Further education of farmers is recommended to ensure the correct application of the pesticides.

Regarding the misuse of pesticides for hunting and fishing purposes, the author was informed that pesticides namely Dithane, Klerat and Phostoxin are used to trap grasscutters in parts of the region whilst Elocron, Unden and Gammalin 20 are used for fishing in parts of the River Offin.

(v) Brong-Ahafo region

Information gathered from this region regarding the misuse of pesticides centred around vegetables especially tomatoes which are cultivated in areas around Bechem, Techiman, Wenchi, Sunyani and Berekum. According to some of the informants, during periods of glut, some farmers delay the ripening of tomatoes through the addition of excess fertilizer to the soil. During periods of scarcity however, the tomato farms are sprayed with the fungicide Cocobre (normally used against capsid and black pod diseases of cocoa) which they claim accelerates ripening. By so doing a good price is obtained for the produce.

Reports were also made of DDT and Phostoxin being used together during the storage of maize in traditional cribs by some small-scale farmers in the region.

(vi) Volta Region

The use of pesticides namely Gammalin 20 and Unden for fishing in parts of the River Volta was reported.

An outbreak of food poisoning due to alkyl-mercury fungicide in a a village in this region has been documented (8). This occurred at Yalovi near Akatsi. A total of 144 cases of alkyl-mercury poisoning was reported. The patients out of ignorance had washed, processed and consumed seed maize dressed with methoxyethyl mercuric acetate. Twenty people died as a result.

4.4 Contaminants occuring naturally in food

4.4.1. Cyanogenetic glycosides

These are compounds which yield hydrogen cyanide upon treatment with acid or the appropriate hydrolytic enzymes. Hydrogen cyanide may also be released when tissues of the plant are crushed or otherwise disrupted.

Cassava (Manihot utilissima) which is a basic food crop in this country is known to contain the cyanogenetic glycosides linamarin and lotaustralin. These are reduced to safe levels by the traditional methods of processing and preparation which include peeling, grating, fermentation, roasting, boiling or steaming. Some varieties of cassava are however known to contain extremely high levels of glycosides.

The author during the literature search found only one documented case of food poisoning due to cyanogenetic glycosides (9). This occurred at Nuaso Village in the Eastern region of the country. Thirty one people were affected after eating a meal containing "kokonte" (cassava flour). No deaths were recorded and the food samples were found to contain significant quantities of cyanogenetic glycosides. According to some informants however, there have been other undocumented cases of poisoning resulting from the consumption of cassava in the country especially during the drought period of 1983. Whether these were due to glycosides is not known.

In the country, the dried leaf sheaths and sometimes the adjoining part of the stem of the plant Sorghum caudatum are used during the preparation of "Rice and beans" (Waakye) to impart a deep red or purple colour to the food. This has gained the leaves

the name "Maakye baa" meaning leaves for "Maakye." These leaves are sold in small bundles in several markets. The plant is not extensively cultivated in the country and it is used for dyeing mats and cloth in some neighbouring countries. The leaves of another variety of the plant, Sorghum vulgare have been found to contain the cyanogenetic glycoside dhurrin at a level of 200ug HCN/g (10). No literature was found regarding the dhurrin content of Sorghum caudatum and this may be worth investigating.

Lima bean from the plant Phaseolus lunatus in utilised to a small extent in the country. This plant is also documented as containing the cyanogenetic glycoside linamarin in several parts especially the seed (11).

Apart from plants utilized as foodstuffs, several others are consumed for their medicinal properties. Various parts of some of such plants are known to contain glycosides. An example being the leaves and bark of the Nim tree (Azadiracta indica) which are used in the preparation of decoctions for the treatment of malaria fever in the country.

4.4.2 Vaso-and psycho-active substances in food

Many foods in their natural state contain numerous amines, several of which are called biogenic amines because of their biological roles. Normally these amines are not harmful, but they can in some sensitive subjects have harmful effects which are more pronounced when they interfere with the effects of medicaments.

In most parts of the country, fruits such as banana, pineapple, orange and passion fruit amongst others are consumed as snacks and for desserts. Some foods including these fruits have been documented as containing vaso-active amines such as serotonin, tyramine and dopamine. The levels of some of these amines in some selected foods are given in Table 5.

Furthermore, some plants contain compounds which cause varying degrees of stimulation or depression. Foods containing these compounds are usually ingested because of ignorance of their effects. There is however a growing interest in plants containing hallucinogenic compounds for purposeful consumption. Table 6 shows some popular foods/plants used in the country and their psycho-active constituents.

Table 5 Amine content of selected foods (mg/100g of fresh food)

Food	Serotonin	Tyramine	Dopamine
Banana (pulp)	2.8	0.7	0.8
Banana (skin)	5 - 15	6.5	70
Pineapple (ripe)	2	-	-
Pineapple (juice)	2.5 - 3.5	-	-
Avocado	1.0	2.3	5
Passion fruit	0.1 - 0.4	-	-
Tomato	1.2	0.4	0
Egg plant	0.2	0.3	0
Potato	0	0.1	0
Orange	0	1.0	0

Source: Ferrando, R. 1981 (11).

Table 6: Psycho-active constituents of some popular foods/plants used in Ghana

Food/Plant	Botanical names	Psycho-active constituent	Source
Yam	Dioscorea dumetorum	Dihydrodioscorine	(12)
Potato(Irish)	Solanum tuberosum	Solanine and its aglycone solanidine	(13)
Kola nut	Cola acuminata	Caffeine and theobromine	(13) & (14)
Coffee	Coffea arabica	Caffeine	(11)
Tobacco	Nicotiana tabacum	Nicotine	(11)
Cocoa	Theobroma cacao	Theobromine	(15)
Tea	Camellia sinensis	Caffeine, theobromine, theophylline	(15)
Nutmeg	Myristica fragrans	Myristicin	(11)
African Pepper	Xylopia aethiopica	Anonaceine	(13)
"Bitter leaf"	Vernonia amygdalina	Vernonine	(16)

4.4.3 Natural Sulphur compounds

These compounds are present in some plants but they are so distributed in a manner that when plants containing them are used in the conventional manner they are harmless. Exceptions do however exist . Certain cruciferous plants contain glucosinolates whilst onions, garlic and chives have sulphur-containing compounds that arise from enzyme action on precursors in the plants giving these members of the Allium genus their characteristic taste and smell.

Cabbage, cauliflower and brocooli contain the glucosinolates sinigrin, glucobrassicin and gluconapin respectively. These vegetables are not indigenous to the Ghanaian diet and their consumption in the country can be said to be a result of exposure to the western culture. They are therefore only found in some major cities such as Accra, Kumasi, Takoradi and Cape Coast.

Three members of the Allium genus are however commonly used in cooking in the country. These are Onion (A. cepa), Shallots (A. ascalonicum) and Garlic (A. sativum). They are used mostly in the preparation of soups and stews and as seasoning for meats, fish and "khebabs" (barbecue). The major precursor in onion is trans-(+)-s-(propen-1-yl)-L-cysteine sulfoxide present at about 2mg/g fresh weight. In garlic, the precursors are S-substituted cysteine sulfoxides or peptides containing them of which (+)-s-allyl-L-cysteine sulfoxide (allicin) is the major one present at about 2.4mg/g fresh weight (14). There is however little evidence that sulphur containing compounds in the Allium species are harmful as consumed in edible products.

4.4.4 Plant phenolics

Several plants have been identified as containing phenols which are acute toxicants whilst others contain vesicant phenols. Those identified include cashew and mango which are popular fruits in the country and are listed as containing vesicant phenols (14). Marijuana (Cannabis sativa), named as a popular adulterant in "Akpeteshie"(a locally-distilled alcoholic beverage) in Section 3.2.8 (ii) also contains an active phenolic compound, likewise nutmeg which is used as flavouring in cakes, doughnuts, pastries and sometimes in sauces and stews in the country.

Tangerine and orange are everyday fruits in most parts of the country and as stated earlier used as snacks and desserts. These have been documented as containing the phenolic toxicants, tangeretin and nobiletin whilst a third citrus fruit not as popular as the first two in the country grapefruit, contains the flavonol analogue of nobiletin (3,3,4',5,6,7,8 - hepta-methoxyflavone). These toxicants are however confined to the oil receptacles such as the peel which are not normally eaten but are sometimes used in the preparation of marmalades.

Tannins are responsible for the astringent flavour of unripe fruits and when present in the diet make it astringent. Whilst it would appear unlikely that plant phenols usually present in human diets would produce significant toxic effects, in some cases however, the amounts consumed may reach high levels and produce some negative effects especially when the diet is suboptimal as may be caused by famine. Among the foods known to contain tannins are sorghum, coffee, tea, leaves of the silk-cotton tree and kola-nuts which are used as a stimulant in parts of the country especially the northern sector and named as a popular adulterant for ground pepper in parts of the country (Section 3.2.4).

4.4.5 Fungal toxins

The Inter-Tropical Convergence Zone affects the southern half of the country making this area generally very humid, creating very humid conditions which are highly conducive to mould growth and therefore possible mycotoxin contamination.

Several mycotoxins have been discovered to date and the most toxic are the aflatoxins. The minimum optimum and maximum temperatures for aflatoxin production are 12, 27 and 40-42°C respectively (17). A list of mycotoxins detected as natural contaminants is given in Annex 1.

Presently, there is no aflatoxin monitoring system in Ghana. Isolated studies have however revealed contamination of some locally-grown agricultural commodities by aflatoxins. Groundnuts purchased from markets in the Accra area had levels ranging from 3 to 216ppb (18). The author just before taking up this assignment attended a three-month specialist course on Aflatoxin Analysis and Mycotoxins at the Overseas Development Natural Resources Institute in London. During this course, she analysed maize samples obtained from storage structures in the Ashanti and Brong-Ahafo regions of Ghana. All fifteen samples examined were positive for aflatoxins with a range 20 to 399 ppb. Thirteen samples had aflatoxin levels above 30 ppb, the FAO/WHO maximum tolerance limit.

It is to be noted that food contaminants such as aflatoxins which occur unevenly and at levels influenced by environmental conditions can be controlled only by constant monitoring of the foods likely to be contaminated. In this regard, an aflatoxin unit is currently being established at the Food Research Institute. This unit may be incorporated into any National Food Contamination Monitoring Programme.

.4.6 Toxicants occuring naturally in spices and flavours

There are to date eleven substances that occur naturally in current or recent use that could reasonably be included in a list of substances generally regarded as toxic (14). These include hydrogen cyanide found in a number of glycosides, allyl isothiocyanate, capsaicin found in red pepper, coumarin which is widely distributed in a number of substances that are natural sources of flavours, menthol, a major constituent of peppermint oil in mint, myristicin found in both nutmeg and mace as well as in black pepper, parsley and some members of the carrot family (Umbelliferae), and safrole which is a minor or trace constituent in mace, nutmeg and black pepper amongst others.

In the country, several herbs and spices are added to cooking for various reasons such as the enhancement and improvement of the flavour and taste of food as well as for medicinal purposes.

A list of the common herbs and spices used in the country is given in Annex 2. This includes red, and black peppers, mint, and nutmeg which have been mentioned as containing toxic substances. Further research work and documentation on the toxic constituents of local herbs and spices is recommended.

4.4.7 Some other naturally-occuring toxicants

Toxic proteins and peptides are known to occur naturally in plants. These include agglutinins found in several edible fruits (bananas, mangoes), seeds (wheat germ) and tubers such as potatoes. Other plants such as legumes are also known to contain toxic factors such as enzyme inhibitors and hemagglutinins.

Bacterial toxins are produced by certain strains of Staphylococcus aureus and Clostridium botulinum. St. aureus being frequent inhabitants of the skin and mucosal surfaces of the upper respiratory tract, are readily transferred to food through sneezing, contaminated hands or through food handlers with skin lesions. Cl. botulinum however, are found in the soil and aquatic environments and are therefore likely to contaminate fish and other marine life. The author in the literature survey came across only one documented case of poisoning due to bacterial toxins in the country (20). This was a Staphylococcal food poisoning which occurred at Anum, a village near Peki in the Volta Region. It involved twelve members of a family after they had eaten a dessert of salted bean cake (kosei). One death was recorded.

The "Miraculous Berry" (Synsepalum dulcificum) mentioned in Section 3.2.8 (i) as an adulterant in palm-wine in parts of the country contains a glycoprotein which researchers believe binds to the receptors of the taste buds thereby modifying their function (14).

Hypoglycins are toxic and may act as riboflavin antimetabolites. The unripe fruit of "Ackee" (Blighia sapida) contains two nitrogen compounds hypoglycin A (α-amino-β-cyclopropanyl-propionic acid) and hypoglycin B (a dipeptide) which are known to cause acute hypoglycemia. This plant is present in the country though not very common. According to informants, although the fruit is not eaten, the bark of the tree is consumed in food for medicinal purposes.

4.5 Environmental or industrial pollution

4.5.1 Effluents from industry

Ghana is primarily an agricultural country but efforts are being made to diversify the economy by embarking on industrialization. The country therefore has several manufacturing industries in addition to various mining concerns.

Wastes from industries are known to include poisonous substances which can enter foods from contaminated soil, water and air. Industrial effluents may sometimes contain high levels of copper and zinc which are harmful to fish life, arsenic and cyanide which are dangerous to human life and other toxic compounds such as the alkyl compounds of mercury which are readily absorbed through the respiratory or gastrointestinal routes and are only slowly eliminated from the body. Poisoning of fish may occur after the discharge of several forms of mercury into natural water bodies as these are converted to alkyl mercury which then accumulates to dangerous levels in the rungs of the biologic food chains.

In parts of Ghana, there is uncontrolled discharge of industrial waste and raw sewage into water-bodies and there have been instances of the waters becoming polluted and as a result, foul-smelling. A typical example is the Korle-Lagoon in the Greater Accra region. Though it can be said that water pollution caused by the discharge of industrial wastes into rivers is probably not widespread, there is cause to suspect that localised water pollution is occurring in some parts of the country especially in the mining areas and some urban towns.

A survey carried out by the Water Resources Research Institute of the Council for Scientific and Industrial Research (CSIR), revealed that most factories are sited near rivers and that large volumes of untreated industrial effluents are discharged in most cases directly into the river courses (19). These rivers apart from being sources of fish and other seafoods, are major sources of domestic water supply for a large proportion of the rural population who use this water untreated. The affected rivers are the Ofin, Birim, Volta, Densu, Ankobra and some of their major tributaries.

There are no complete systematic physico-chemical and biological data on these rivers to help evaluate the extent of pollution, only a knowledge of the types of effluents being discharged from particular industries is available. This is summarized in Table 7.

Table 7 : Major rivers and lagoons in Ghana receiving industrial effluents

River/Lagoon	Industries discharging effluents	Type and nature of effluents
R. Ankobra	Tarkwa gold mines	Contained arsenic, cyanide, iron, copper, zinc, lime and traces of gold
	Prestea gold mines	- do -
	Bonsaso rubber and tyre factory	Black in colour, contained serum (protein) extracted from the latex, dirt and acid
	Aboso glass factory	contained traces of oil
	Nsuta manganese mines	Contained fine clay and laterite and traces of oil
R. Birim	Akwatia diamond mines	Yellowish-brown colour and heavily loaded with suspended solids and oil
	Oda diamond mines	-do-
	Kade diamond mines	-do-
R. Ofin	Dunkwa-on-Ofin rubber factory	Contained dirt acid and serum from latex
	Obuasi goldmines	Contained arsenic (5.9ppm) and suspended solids.
R. Volta	Akosombo and Juapong textile factories	Contained organic colour indigo, diazo dyestuffs, phthalogen dyestuffs and mineral acids
R. Densu	Nsawam fruit and vegetable cannery	Fruit and vegetable juice, pulp and their washings.
R. Odaw	Achimota brewery	Contained mineral acids, detergents and dirt.
Korle lagoon	Accra brewery	Contained mineral acids, detergents and dirt.

Source: Water Quality and Pollution Survey (19).

High levels of arsenic (5.9ppm) were detected in effluents discharged into River Ofin from the Obuasi goldmines and samples taken from a stream receiving effluents from the Prestea goldmines showed free cyanide levels at 3ppm at the point where the stream joins the River Ankobra.

The author during a brief discussion with the Legal Secretary of the Environmental Protection Council, Mr. Osafo, was informed about the non-existence of laws regarding the disposal of industrial wastes into water-bodies in the country. Specific cases are however considered as and when they occur. A recent case cited was the discharge of untreated effluents from the Achimota Brewery into the River Odaw in the Greater Accra region. According to the official, this situation has been discussed with the appropriate authorities and the effluents are now treated before being discharged into the river and furthermore, regular checks are conducted by the Council to ensure strict compliance with the measure.

At the Ghana Standards Board Laboratories, mercury levels determined in Tuna fish caught in Ghanaian waters by a fish canning industry between 1982 and 1984 ranged from 0.01 to 0.11mg/kg.

The author wishes to draw attention to a reported case of arsenic poisoning in Ghana (21). This occurred at Prestea, a gold mining community in the Western region, Rain-water was found to contain 6ppm, creekwater, 80ppm and vegetation in the area contained 170ppm and up to6,000 ppm in dry matter. Urine samples of people living in the immediate vicinity showed 2ppm and their hair samples contained 500ppm of arsenic.

There is therefore the need for laws to be enacted to prevent environmental degradation and to protect the health of the population, Regarding this, I was informed about on-going studies at the Industrial Research Institute of the C.S.I.R. on the disposal of industrial wastes in the country. The Institute is currently collating information regarding the disposal of solid, liquid and

other waste materials to be able to formulate a national programme which will help the Government to enact laws to prevent environmental pollution and degradation. Furthermore, the Institute of Aquatic Biology also of the C.S.I.R and the Environmental Protection Council are jointly undertaking a survey along the coast of Ghana to determine pollution levels from waste disposal. This survey is being conducted under the West and Central African Marine Pollution Programme being sponsored by the United Nations Development Programme (UNDP).

4.5.2 Other forms of environmental pollution

The practice of applying municipal sewage sludge to agricultural land as a top-dressing can result in metallic contamination of food because a wide variety of potentially toxic metals can find their way into sewage sludge and municipal compost. Boron for instance from the use of washing powders and zinc from the weathering of galvanized iron roofs, fences and piping (6).

In the Greater Accra region, almost all the region's waste used to be discharged into the sea untreated until the commissioning of the Waste Management Project of the Accra Metropolitan Authority in June 1980. Now almost all the waste from the city of Accra is composted for horticultural and agricultural use. Compost depots are located at Achimota, Kaneshie and Teshie-Nungua. In the other regions however, untreated sewage is disposed of in dug trenches on the outskirts of cities and sometimes into rivers such as Subin River in the Ashanti region.

Vegetable farming along the edges of roads is a common practice especially in the city of Accra. Contamination of food by lead and cadmium is sometimes a result of air pollution from automobile exhaust pipes. It has been noted that along the edges of roads there can be up to 100mg of lead per kilogramme of grass on a dry weight basis, and the feeding of cows with such

fodder leads to an increase of lead in their milk, and their faeces naturally increase the amount of lead in the soil giving rise to another form of pollution (22). The practice of roadside farming should therefore be discouraged especially in large cities with much vehicular traffic.

5. RECOMMENDATIONS

Food Laws

There is the urgent need for the promulgation of the draft food laws of the country. This is to ensure that the consumer receives safe, wholesome, and unadulterated food produced under appropriate conditions and presented in a manner that is not misleading to him.

Once promulgated, steps should be taken to ensure strict compliance with the provisions of the law. In this connection, the enforcement institutions need to have well-trained personnel in addition to well-equiped laboratories.

Regulations should be made in the areas of food hygiene, food additives, and contaminants. These regulations should include the maximum acceptable limits for the additives and contaminants.

Monitoring of contaminants.

A national food contamination monitoring programme should be established and backed with the relevant laboratory facilities to monitor the levels of contaminants such as the aflatoxins, pesticide residues and heavy metals in foods in the country.

Establishments such as the Ghana Standards Board, the Food Research Institute of the Council for Scientific and Industrial Research, the Environmental Protection Council and the Ghana Atomic Energy Commission

may be involved in the realisation of such a programme.

Public education programmes

Public education programmes need to be carried out on:

(i) the sale and use of additives such as food colours, and the harmful effects resulting from their excessive usage.

(ii) the need to observe high levels of sanitary and hygienic conditions and practices during the manufacture, processing and handling of food.

(iii) the immediate and probable cumulative effects resulting from the misuse of pesticides especially for hunting and fishing purposes on the health of the population.

Areas for further research

Further research needs to be conducted into the following areas:

(i) the development of appropriate small-scale processing and preservation equipment to help up-grade existing traditional processing techniques.

(ii) contaminants present in various packaging materials in use in the country and their possible toxic effects on the consumer.

(iii) naturally occurring contaminants present in foods consumed in the country.

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Annex 1: Mycotoxins detected as natural contaminants

Mycotoxins	Toxin-producing mould	Substrate on which the toxin is produced as a natural contaminant	Major pathological effects of the toxin	Host
Ergotamine	Claviceps purpurea	Rye	Gangrene of the extremities	Humans and animals
Aflatoxins				
B_1 - B_2	A. flavus	Groundnuts	Liver syndrone	Poultry
G_1 - G_2	A. parasiticus	Cereals	Liver cancers	Ducks
M_1 - M_2				Cattle
P_1				Humans
Ochratoxins	A. ochraceus	Maize	Fatty infiltration of liver,	Poultry
	P. viridicatum	Barley	Kidney lesions	
Zearalenone	Fusarium graminearum	Maize-hay-feeds	Hyper-Oestrogenic	Cattle
Citrinin	P. citrinin	Barley, rye, oats	Kidney symptons	Pigs
Patulin	A. clavatus P. expansum P. patulum	Apple, apple juice wheat, straw	Neurotrophic-skin sarcoma	Cattle
Penicillic acid	P. cyclopium	Cereals	Skin sarcomas	Livestock
	P. viridicatum		Pellagra, Coma	
T2 toxin	Fusarium	Cereals	Haemorrhaging syndrone	Livestock
Stergmatocystin	A versicolor	Wheat	Liver cancers	Laboratory animals

Source: Jemmali, M. (23).

Annex 2: Common spices and herbs used in Ghana

Spice/Herb		Uses
Common name	Botanical name	
Ethiopian pepper	Xylopia aethiopica	Flavour in maize porridge, soups and stews. Mixed with other spices in frying ripe plantain (kelewele)
Guinea grains	Aframomum melegnotia	Hot taste in soups, stews and ginger drink.
West African black pepper	Piper guineense	Hot taste in millet porridge, ginger drink and in soups.
Calabash nutmeg	Monodora myristica	Hot taste in fried ripe plantain (kelewele) and ginger drink.
-	Solanum torvum	Flavour in soups.
American basel	Ocimum canum	Flavour in soups and stews.
Cumin	Cuminum cyminum	Flavour in soups and stews.
Cloves	Eugenia caryophyllota	Flavour in soups and stews.
Red pepper or chillies	Capsicum frutenscens	Hot taste in soups, stews, "kolewele".
Onion	Allium cepa	Flavour in soups, stews, sauces and salad.
Garlic	Allium sativum	Flavour in soups and stews and as seasoning for meats and fish.
Shallots	Allium ascalonicum	Flavour in soups, stews and as seasoning for meats, fish, salads.
Red pepper or chillies	Capsicum annum	Garnish to soups and stews.
Ginger	Zingiber officinale	Hot taste in soups, stews, kelewele, ginger drink and seasoning for meat, fish and millet porridge.
Mint	Mentha spicata	Flavour in soups, stews, meat and fish.
Tea bush	Ocinum viride	Flavour in soups, stews and fish dishes, Also used to cure stomach upsets.

Spice/Herb		Uses
Common name	Botanical name	
Thyme	Thymus vulgaris	Seasoning and flavouring for meat and fish dishes.
Bay leaves	Laurus nobilis	Flavour in soups, meat and fish dishes.

Source: Shoetan, E. (24).