DRAFT TANZANIA STANDARD

Code of practice for the reduction of contamination of food with polycyclic aromatic hydrocarbons (PAHs) from smoking and direct drying processes

TANZANIA BUREAU OF STANDARDS

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Foreword

This Tanzania Standard was approved under the authority of the Board of Director of Tanzania Bureau of Standards.

Tanzania Bureau of Standards (TBS) is the statutory national standards body for Tanzania established by the Standards Act Cap. 130.

Tanzania Standards are developed through Technical Committees that are representative of key stakeholders including government, academia, consumer groups, private sector and other interested parties. The Technical Committees work under the supervision of Divisional (sectoral) Committees. The Standards are developed in accordance with the Guide and Procedure for Development of Tanzania Standards and TZS 0, *Guide for presentation of Tanzania Standards*.

Tanzania Standards are subject to review, to keep pace with science and technological advances. Users of the Tanzania Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

This Tanzania Standard was developed under the supervision of the Agriculture and Food Divisional Standards Committee [AFDC]. The Technical Committee responsible for the standard is AFDC 27- Contaminants.

The reporting of the result of a test or analysis made in accordance with this Tanzania Standard, if the final value, observed or calculated is to be rounded off, shall be done in accordance with TZS 4.

Introduction

Many chemical contaminants are formed during the combustion of fuel and other materials both in the smoking and in the direct drying process. Examples include polycyclic aromatic hydrocarbons (PAHs), dioxins, formaldehyde, nitrogen and sulphur oxides (relevant for formation of e.g. nitrosamines). Furthermore, heavy metals are also found in combustion gases. The types and amounts of contaminants depend on the materials used, the temperature and possible other parameters.

Hundreds of individual PAHs may be formed and released as a result of incomplete combustion or pyrolysis of organic matter, during forest fires and volcanic eruptions as well as industrial processes or other human activities, including the processing and preparation of food. Owing to their mode of formation, PAHs are ubiquitous in the environment and therefore can enter the food chain, especially via air and soil. PAHs can be present in the raw materials due to environmental contamination from the air by deposition on crops, soils and transfer from water to fresh and marine invertebrates. Commercial and domestic food preparation such as smoking, drying, roasting, baking, barbecuing or frying are recognized as important sources of food contamination. Presence of PAHs in vegetable oils can also originate from smoking and drying processes used to dry oil seeds prior to oil extraction.

PAHs are toxic chemicals which when taken through food and feed can pose various health effects such as cancer, skin, eyes, kidneys, and liver diseases. Animal studies have shown adverse effects in reproductive and general developmental processes. The major routes of exposure to PAHs in the general population are inhalation, ingestion, smoking cigarettes, or breathing from open fireplaces.

Contamination of food with PAHs via environmental contamination should be controlled by either source-directed measures like filtering the smoke from relevant industries (e.g. cement work, incinerator and metallurgy) and limiting the exhaust fumes of PAHs from cars. Good practices, including the selection of appropriate farmland/fishing waters, could also decrease the environmental contamination of raw materials with PAH. However, this contribution to the reduction of PAHs intake from the final food is not included in this Code of Practice.

The major sources of PAHs are cereals and cereal products (owing to high consumption in the diets) and vegetable fats and oils (owing to higher concentrations of PAHs in this food group). Generally, despite their usually higher concentrations of PAHs, smoked fish and meats and barbecued foods do not contribute significantly, particularly as they are small components of the diet. However, they do make larger contributions leading to higher PAHs intake where these foods make up a large part of the diet.

This Code of Practice intends to provide guidance for national authorities and manufactures, and consumers to prevent and reduce contamination of food with PAHs in commercial smoking and direct drying processes. For this purpose, this Code of Practice identifies important points to consider and provides relevant recommendations.

1. Scope

This Code of Practice provides guidance on reduction of PAH contamination of food during direct and indirect smoking, and direct drying processes. It does not cover PAH contamination originating from the use of herbs and spices in the smoking process; indirect drying; barbecuing and other types of cooking in private homes or the catering sector; and environmental contamination of raw materials.

2. Normative references

There are no normative references in this document.

3. Terms and definitions

For the purposes of this Tanzania standard, the following terms and definitions apply:

3.1 Contaminant

any substance not intentionally added to food, which is present in such food as a result of the production (including operations carried out in crop husbandry, animal husbandry and veterinary medicine), manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food or as a result of environmental contamination. The term does not include insect fragments, rodent hairs and other extraneous matter

3.2 direct drying

drying process where the combustion gases come into direct contact with the foods

3.3 sun drying

direct drying process where sunshine and wind are used for drying under circumstances open to the environment

3.4 indirect drying

drying process where the combustion gases do not come into direct contact with the foods, where the hot air is heated via a heat exchanger, electricity or by other means

3.5 Hazard Analysis Critical Control Point (HACCP)

system which identifies, evaluates, and controls hazards which are significant for food safety

3.6 other plant materials

covering other types of fuels than woods used in the smoking or drying process, e.g. bagasse, corn cobs, saw dusts, dry grasses, rice husks, coconut husks, and shells

3.7 Polycyclic aromatic hydrocarbons (PAHs)

group of contaminants that constitute a large class of organic compounds containing two or more fused aromatic rings made up of carbon and hydrogen atoms

3.8 pyrolysis

chemical decomposition of organic materials by heating in the absence of oxygen or any other reagents, except possibly steam

3.9 smoke

gaseous products of burning materials especially of organic origin consisting of suspended liquid and solid particulates

3.10 smoke condensates

products obtained by controlled thermal degradation of wood in a limited supply of oxygen (pyrolysis), subsequent condensation of the resulting smoke vapours, and fractionation of the resulting liquid products

3.11 smoking of food

process used as a preservation method to prolong the shelf life of food due to components of the smoke inhibiting growth of some microorganisms

3.12 direct smoking

smoking process, where the smoke is developed in the chamber in which the food is processed

3.13 indirect smoking

process where smoke generators are used, and the smoke is being developed in a chamber, separate from where the food is smoked

4. General principles for reducing PAH contamination in food

The food producer should be aware of the conditions under which higher levels of PAHs are generated and wherever possible, should control those conditions to minimize their formation. To accomplish this, an analysis of important points to consider in processes used or intended to be used in food production with smoking or direct drying should be carried out.

The first step of the analysis is to identify important points to consider. Possible major important points to consider include:

a) Possible sources of PAHs from the environment and the process;

b) Possible effects on consumer health;

c) Controllability; and

d) Possible measures to reduce PAH contamination.

The producer should take appropriate measures to control the identified important points for reducing PAHs, based on the results of the analysis and other legitimate factors relevant for human health protection and economic activities such as:

a) The microbiological status and possible risks from other contaminants;

b) The organoleptic properties and quality of the final product (the ideal method would have no adverse effects on the appearance, flavour, taste or nutritional properties of the product); and

c) Feasibility and effectiveness of controls (cost, commercial availability, occupational hazards).

The producer should monitor the effects of the implemented measures and should review them if necessary.

5. Evaluation of compliance with relevant legislations

Processed food shall be in compliance with relevant national legislations and standards, including general requirements for consumer protection. Furthermore, food shall be produced in accordance with relevant national codes of practice. Some of these may contain further information about drying or smoking, which should also be considered.

The formation of PAHs during smoking and direct drying is dependent on a number of variables, including:

a) Fuel (woods and other plant materials, diesel, gases, liquid/solid waste and other fuels);

b) Smoking or drying method (direct or indirect);

c) Smoke generation process in relation to the temperature of pyrolysis and to airflow in the case of a smoke generator (friction, smouldering, thermostated plates) or in relation with other methods such as direct smoking or regenerated smoke by atomizing smoke condensate (liquid smoke);

d) The distance between the food and the heat source;

e) Position of the food in relation to the heat source;

f) Fat content of the food and what happens to it during processing;

g) Duration of smoking and direct drying;

h) Temperature during smoking and direct drying;

i) Cleanliness and maintenance of equipment; and

j) Design of the smoking chamber and the equipment used for smoke/air mixture (which influences the smoke density in the smoking chamber).

In general, changes in processing techniques can in some cases reduce the amount of PAHs formed during processing. Indirect drying or smoking processes result in lower PAH contents than direct drying or smoking. Also the use of smoke condensates, selection of fuel such as type of wood and adjusting times and processing temperatures influences the PAH formation. Addition of activated carbon to coconut oil at the right dosage during the refining process can completely remove PAH contamination.

Application of an HACCP system in accordance with the principles and steps as recommended is one of options for reducing PAHs.

6. Smoking

Smoking has been used for centuries as a method for preserving meat and fish. Smoking impregnates the high-protein food with aromatic components, which lend flavour and colour to the food, and also play a bacteriostatic and antioxidant role.

6.1 Fuel used in smoking

6.1.1 For smoking of food, woods are normally used, but other types of fuels like bagasse (plant materials from sugarcane), corn cobs and coconut husks and shells are used. The fuel used is an important point to consider for the potential contaminants of the food, e.g. the PAH contamination of food varies with type of fuel used for smoking. PAH contamination of oil seed is higher when using coconut husks compared to coconut shells due to higher lignin content of the husks.

6.1.2 The type of fuel used has an influence on PAH formation. It is recommended that the different types of fuel should be evaluated in relation to PAH formation before use. The use of fuels other than wood and other plant materials for the purpose of smoking foodstuffs should be avoided. Fuels like diesel, rubber (e.g. tyres) or waste oil must not be used even as a partial component, as they may lead to significantly increased PAH levels.

6.1.3 Resinous wood is not preferred for smoking processes. Moreover, woods treated with chemicals such as for preserving, waterproofing, fireproofing etc. should not be used for smoking or the production of smoke condensates. Such treatments may result in tainting of the food as well as the introduction of other contaminants, e.g. dioxin from woods treated with pentachlorophenol (PCP).

6.2 Foodstuffs

6.2.1 The position of the food in the smoke chamber and the distance between the food and the heat source is an important point to consider in the smoking process. As PAHs are particle bound, a greater distance from the smoke source to the smoked food might reduce content of PAHs in the food.

6.2.2 During direct smoking, fat dripping from the food into the source of the smoke, e.g. glowing wood or other plant materials might increase the content of PAHs in the smoke and thereby in the smoked food. In order to

avoid an increase in the PAH content through fat drippings into the open fire, perforated metal sheets can be installed between the food to be smoked and the heat source.

6.2.3 The quality of the final food product must be evaluated to ensure compliance with set standards.

6.2.4 The organoleptic properties of the final products are an essential part of their characteristics.

6.3 Processing

6.3.1 Four types of smoking techniques are generally recognized: smouldering, thermostated plates, friction processes, and smoking with smoke condensates. Friction processes allow smoke to be produced by pyrolysis of wood sawdust, wood chips, and wood logs. Smoke condensates may be used by exposing food to smoke which is reproduced or regenerated by atomizing smoke condensate (liquid smoke) in a smoking chamber.

6.3.2 Smoke is produced by pyrolysis of the fuel at temperatures of around 300-450 °C in the glow zone. To produce smoke for smoking food, flames should be avoided, including by adjusting airflow.

6.3.3 Differences in the smoking processes can lead to highly variable PAH levels in the final food product. The choice of technology for processing is very important for the final concentration of PAHs. Identifying the parameters critical for PAH formation in a specific process may potentially be useful to control PAH levels. Direct smoking requires less equipment than indirect smoking but can result in higher levels of PAH in the final food product.

6.3.4 Replacing direct smoking with indirect smoking can significantly reduce contamination of smoked foods. In modern industrial kilns, an external smoke generator can be operated automatically under controlled conditions, to wash the smoke from particles before coming in contact with the food and to regulate its flow as it is brought into contact with the food. For more traditional or smaller scale operations, this may not, however, be an option.

6.3.5 Smoking processes are often divided into three groups depending on the temperatures used in the smoke chamber during processing:

a) Cold smoking with temperature of approximately 18–25 °C. It is used for smoking e.g. some fish species and salami-type sausages;

b) Semi-warm smoking with temperatures of approximately 30–40 °C. It is used for smoking e.g. some fish species, bacon and pork loin; and

c) Warm (or hot) smoking is smoking combined with heating resulting in a temperature of approximately 70–90 °C. It is used for smoking e.g. some fish species, hams, and frankfurter type sausages.

6.3.6 The type of generator used should be based on an assessment of possible reduction of the PAH content in the final food and where possible include washing of the smoke after the generator and before the smoke chamber. Good results are achieved by installing baffles after the smoke generator equipped with a device for decantation of tar. A more efficient way is to manage the pyrolysis temperature and decanting of heavy phase tanks to a cooling device with baffles.

6.3.7 The scientific background and data to illustrate the exact influence of the use of different types of fuel, time, temperature etc. is limited and specific testing is needed for the identification of important points to consider in the individual processes. However, reduction of PAH levels can be achieved using the appropriate fuel, placing the food at a distance from the heat source or using a barrier between the heat source and food, reducing the duration and temperature of the process. In addition, other methods like use of long pipes in the equipment can reduce the PAHs.

6.3.8 As PAHs are particulate bound, a filter may be used to remove particulate material from the smoke. This should reduce potential contamination with PAHs.

6.3.9 Oxygen needs to be balanced as both too much and too little oxygen produces PAHs. Adequate oxygen for partial/incomplete combustion of the fuel is needed to produce smoke. However, too much oxygen may raise the temperature in the glow zone and lead to increased formation of PAHs. Lack of oxygen may lead to the formation of more PAHs, as well as production of carbon monoxide, which may be hazardous to operators.

6.3.10 Temperature is of importance for the partial/incomplete combustion of the fuel. Generally, PAH formation increases with increasing temperature. The composition of the smoke depends on the temperature, which should be adjusted to minimize PAH formation. However, more data is needed to document which temperatures would be recommendable.

6.3.11 In principle, the smoking time should be as short as possible to minimize the exposure of the food surfaces to PAH-bearing smoke. However, in the case of hot smoking, when the product is being cooked at the same time, it will be essential to allow sufficient time for the product to be cooked thoroughly. In case hot smoke is the only heat source (traditional smoke houses), the smoking chamber should be heated before the food products are placed in it. Smoking time is not an important parameter as long as the source for smoke is well managed. Moreover, short smoking times may have an impact on food safety and shelf life. Clearly preventive measures cannot be taken in isolation from other considerations and it is vital that they do not adversely impact on the sensory properties and consumer acceptance of the product. Additionally, microbiological stability and nutritional properties need to remain unimpaired and care needs to be taken to ensure that other contaminants are not inadvertently introduced.

6.3.12 Because smoke condensates are produced from smoke that is subjected to fractionation and purification, products made with condensed smoke generally have lower PAH levels than products made with freshly generated smoke.

6.4 Post smoking treatment

6.4.1 There are three types of cleaning steps to be used either during processing or as post process treatment:

a) During the process smoke may be washed before it enters the smoking chamber. This can be achieved by washing (scrubbing), using a tar condenser, cooling or filtering all of which can remove particle-bound PAHs from the smoke;

b) Post smoking treatment involves the cleaning of the smoked product itself. In this case rinsing the product or immersing it into water may remove soot and particles containing PAHs on the surface of the food. This type of cleaning would not be possible to use for all types of products, e.g. not for smoked fish and fishery products; and

c) The shaving off the surface of the smoked product itself. In case of solid smoked food this cleaning can reduce PAHs in the final product.

6.4.2 When possible, washing or water-cooling of smoke should be used to reduce the content of PAHs in the final food. Water-cooling is already used in the meat industry. Washing the product after the process may remove PAH-containing particles from the surface of the product.

6.4.3 Washing of the product should not be used for fishery products as it could result in lower organoleptic quality and increased microbiological risks. Fish products are often smoked as the whole fish with the skin, and if the skin is not eaten, some contamination is removed together with the skin. The recommendation could be to prioritize smoking of fish with skin and, preferably, removing the skin before consumption.

7. Important points to consider and recommendations on smoking

PAH content of smoked foods can be minimized by identifying and evaluating the important points to consider mentioned below, and by taking appropriate measures. An HACCP system might be applied.

7.1 Fuel:

a) The type and composition of wood used to smoke foods, including age and lignin content in the wood used should be considered. In general, conifer woods containing higher lignin contents should be avoided;

b) Monitor the water content of the fuel. Lower water content may lead to rapid burning of fuel and higher PAH levels;

c) When individual types of woods and other types of plant materials like bagasse (from sugarcane), corn cobs and coconut husks and shells are used, their use should be evaluated in light of PAH contamination;

d) Do not use woods treated with chemicals;

e) The use of fuels other than woods and plant materials: Do not use diesel, kerosene, waste products, especially rubber tyres and waste oil which may lead to significant levels of PAHs; and

f) Influence on the taste of the final food.

7.2 Smoke developed and used in the process:

a) The composition of the smoke depends on e.g. the type of wood or other plant materials, the amount of oxygen present and the temperature of pyrolysis and possibly the length of time for which the plant materials are burned;

b) The design of the smoking chamber and of the equipment used for smoke/air mixture (e.g. length of the pipe in the equipment);

c) Filtering or cooling the smoke where possible;

d) Washing off the smoke between a smoke generator and the smoke chamber where possible and

e) Installation of baffles after the smoke generator equipped with a device for decantation of tar if possible.

7.3 Foodstuffs smoked:

a) The position of the food in the smoke chamber and the distance between the food and the smoke source;

b) Chemical properties and composition of food, e.g. the fat content of the food to be smoked;

c) Deposits of smoke particles on the surface and the suitability of the surface for human consumption. For fish, the recommendation could be to prioritize smoking of fish with skin;

d) The quality of product after processing; and

e) The organoleptic properties of the final food.

7.4 Smoking process:

a) Whether the smoking process is a direct or indirect process. Replace direct smoking with indirect smoking where possible;

b) Prior assessment of smoke generators by taking account of the resulting PAH content in the smoke;

c) Adjusting of the airflow to avoid excessive temperatures during smoke generation;

d) Selecting appropriate smoking chamber and device for treatment of air/smoke mixture;

e) The accessibility of oxygen during the smoking process;

f) Smoking time: Reducing the time that food is in contact with smoke should take into consideration for microbiological safety and quality;

g) Temperatures: Temperature in the glow zone (in the smoke generation step) and temperature of the smoke in the smoking chamber;

h) Perforated metal sheets can be installed between the food to be smoked and the heat source to avoid an increase in the PAH content through fat dripping into the heat source;

i) The cleaning method and schedule applied in the processing unit; and

j) As an alternative to using freshly generated smoke, manufacturers can consider smoking with regenerated smoke from smoke condensates. They can also produce smoke-flavoured products by applying smoke condensates to foods, such as by spraying, dipping, injecting, or soaking.

7.5 Post smoking processes:

The cleaning of the smoked product itself. In this case, soot and particles containing PAHs on the surface of the food may be removed by rinsing the product or immersing it into water. This type of cleaning would not be possible to use for all types of products, e.g. smoked fish and fishery products. Also, washing might lower organoleptic quality and increase microbiological risks.

8. Direct drying

One of the oldest methods of food preservation is direct drying, as it uses less equipment than indirect drying. Direct drying reduces water activity sufficiently to delay or prevent bacterial growth. Direct drying of food can be done either by sunshine or wind or using hot combustion gases. Water is usually removed by evaporation, which creates a hard outer-layer helping to stop microorganisms from entering the food.

9. Considerations in developing preventive measures to reduce the PAH content of dried foods

9.1 Sun drying

9.1.1 When drying by sun or wind, the potential source of PAHs is the environment. Contamination can originate from soil/dust, combustion from industry and traffic as well as forest fires and volcanic eruptions.

9.1.2 Sun-drying of foodstuffs has the advantage of using free energy from the sun or wind. However, the benefits of greater control over the drying environment and drying time, quicker drying and less contamination from dirt, grass and insect particles, coupled with a consumer demand for a cleaner and less contaminated product may make artificial drying (dehydration) more attractive.

9.1.3 A major disadvantage of sun-drying is the exposure of foodstuffs to the environment, e.g. exposure to undesirable weather conditions and to contaminants. Weather conditions, over which the producer has no control, greatly affect the drying rate. Contamination of dried foods with foreign matter is a serious concern. Sun-dried foods are exposed to contamination by windblown dust, seeds, insects, and rodent and bird droppings.

9.1.4 Sun drying of foodstuffs should not take place near industrial point sources of combustion of gas, such as roads with heavy traffic, incinerators, coal-fired power stations, cement works etc., or in the immediate proximity of roads with intense traffic. Contamination from drying in such places is expected to be a special problem for foodstuffs with a large surface area such as spices. However, covered dryers may protect foodstuffs from industrial sources to some extent.

9.2 Direct drying processes, other than sun drying

9.2.1 *Fuel used in direct drying other than sun drying*

Different types of fuel are used in direct drying, e.g. natural gas, peat and mineral oils. For some foods, the effect of fuel choice on taste may be the important points to consider in choosing a fuel. In any event, fuels like diesel, rubber, tyres, lubricants or waste oil must not be used even as a partial component, as they may lead to significantly increased PAH levels.

9.2.2 *Combustion gases*

Drying with combustion gases increases the contamination by 3 - to 10-fold; use of coke as fuel results in much less contamination than use of oil. Direct contact of oil seeds or cereals with combustion products during drying processes has been found to result in contamination with PAHs and should therefore be avoided.

9.3 Foodstuffs dried

Contamination of dried foods e.g. cereals and vegetable oils with PAHs usually occurs during technological processes like direct fire drying, where combustion products may come into contact with the food. Direct contact of

oil seeds or cereals with combustion products during drying processes has been found to result in accumulation of PAHs and should therefore be avoided.

9.4 Direct drying process

9.4.1 Dehydrators are useful for larger drying yards and growers. Dehydration allows a steady production cycle to be maintained, reduces labour costs and is an insurance against unfavourable weather conditions for sun drying. A system using a combination of initial sun drying followed by finish dehydration using other dehydrators can have considerable advantages without loss of food quality.

9.4.2 Common direct drying/heating operations and applications include drying to remove water (and/or other solvents/chemicals) added, left or produced during processing. During direct drying, hot air is blown directly into the foodstuffs and combustion products can therefore directly enter the food. One example of PAH contamination from direct drying is contamination of vegetable oils (including olive residue oils) in which oil has been contaminated with PAHs during technological processes. Another example can be drying oil seeds prior to oil extraction.

9.4.3 Continuous flow drying, where cereals pass the drying area continuously, is a widespread grain drying method. This technique can be used for drying cereals for food. Direct drying is mainly used with temperatures up to 120 ºC for feeds. For foods (cereal grains, malt, etc.), indirect drying (external heat generation) with temperatures between 65 and 80 ºC are mainly used. The time span for both types of drying is between ½ and 1 hour, depending on the initial moisture content of the grain.

9.4.4 Dehydration provides a form of insurance against poor weather conditions that can handicap traditional sun- and shade-drying. Accurate control of the drying conditions (temperature, relative humidity and air movement) essential for efficient dehydration is achieved. Many kinds of fresh fruits, vegetables, herbs, meat, and fish can be dried.

9.4.5 Too high temperature (one that causes visible burning of the product) can cause PAH formation. Where a system with a burner is being used, the temperature of the burner should be sufficient to allow complete combustion of the fuel, as incomplete combustion can lead to PAHs in the drying gases. A good homogeneity of the temperature of the air is important to avoid overheating.

9.4.6 The drying time should be as short as possible to decrease the exposure of the food to the potentially contaminating gases as much as possible.

9.4.7 The use of active carbon is required during refining of the oil as a way to reduce the PAH content after direct drying. A monitoring system for the PAH content should be established and additional refining steps (with active carbon) must be used when the PAH level in the food is unacceptable.

9.4.8 Monitor the combustion gases for CO, monitor the burner (if applicable) for soot accumulation, and check burner settings and burner or fire temperatures.

9.4.9 As drying processes could be a potential source of PAHs in cereals and oil seeds, there is also a need to control the levels of PAHs in agriculture crops after harvest, with particular reference to the source of contamination, as these crops can have a major impact on PAHs intake. Avoid fire drying of seeds, and seek for alternative drying techniques.

9.4.10 Numerous factors, including equipment cost, knowledge, weather and availability of energy sources often result in similar foods being dried in very different ways.

9.4.11 Replacing direct drying with indirect drying can significantly reduce contamination of dried foods. .

10. Important points to consider and recommendations on direct drying, except sun drying

PAH content of foods directly dried can be minimized by replacing direct drying with indirect drying, if possible or by identifying and evaluating the important points to consider mentioned below, and taking appropriate measures. An HACCP system might be applied.

10.1 Fuel:

a) The type and composition of fuel used to dry foods affect the PAH content;

b) Do not use woods treated with chemicals, e.g. preserved wood, painted wood;

c) Monitor the water content of the fuel e.g. wood. Lower water content of wood may lead to rapid burning of the wood and higher PAH levels;

d) Avoid the use of fuels such as diesel, waste products, especially rubber tyres, olive residues, lubricants and waste oil which may increase significant levels of PAHs; and

e) The fuel influences the taste of the final food.

10.2 Drying process:

a) Temperature of the air should be optimal;

b) Minimize the time that food is in contact with combustion gases;

c) Use of active carbon during refining of the oil;

d) Avoid fire drying of oilseeds;

e) Avoid direct contact of oilseeds or cereals with combustion products; and

f) Keep equipment clean and well maintained (especially driers).

Bibliography

CAC/RCP 68-2009, Code of Practice for the reduction of contamination of food with polycyclic aromatic hydrocarbons (PAH) from smoking and direct drying processes.