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**Prevention and reduction of aflatoxin
contamination in peanuts— Code of
practice**

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PUBLIC REVIEW

Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS286 was prepared by Technical Committee RSB/TC 003, *Cereals, pulses, legumes and derived products*.

In the preparation of this standard, reference was made to the following standard (s):

1) XYZ: Title

The assistance derived from the above source is hereby acknowledged with thanks.

This second/third/... edition cancels and replaces the first/second/... edition (RS nnn-n:yyyy), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

(The first/second/third/... edition (RS nnn-n: yyyy) has been reaffirmed by the Board on dd-mm-yyyy.)

RSnnn consists of the following parts, under the general title *Introductory element — Main element*:

— Part n: Part title

— Part [n+1]: Part title

— Part [n+2]: Part title

Committee membership

The following organizations were represented on the Technical Committee on *Cereals, pulses, legumes and derived products* (RSB/TC 003) in the preparation of this standard.

Paragraph of participants

Rwanda Standards Board (RSB) – Secretariat

Introduction

A paragraph.

PUBLIC REVIEW

Prevention and reduction of aflatoxin contamination in peanuts— Code of practice

1 Scope

This Rwanda Standard provides general recommended practices based on Good Agriculture Practices (GAP) and Good Manufacturing Practices (GMP) and complementary management system for the reduction of aflatoxin in groundnuts (peanuts).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

RS 184, *Requirements for hazard analysis critical control points.*

RS CAC/RCP 1, *Code of practice –General principle for food hygiene*

RS 285, *Groundnuts handling, transportation and storage – Code of hygienic practice*

RS 264, *Warehouse and warehousing for bagged storage of cereals and pulses – Requirements.*

3 Terms and definitions

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

3.1

blows(pops)

in-shell nuts which are unusually light-weight due to extensive damage from physiological, mould, insect, or other causes and which can be removed, for example, by an air-separation process

3.2

curing

drying of in-shell groundnuts (peanuts) to a safe moisture level

3.3

farmer's stock groundnuts (peanuts)

in-shell groundnuts (peanuts) as they come from the farm, after separation from the vines by hand and/or mechanical means

3.4

safe water activity

water activity of in-shell and shelled groundnuts (peanuts) that prevents growth of micro-organisms normal to the nut processing and storage environment

3.5

water activity

measure of free moisture in a product and is the water vapour pressure of the substance divided by the vapour pressure of pure water at the same temperature.

4 Recommended practices

4.1 General

Groundnut shall be produced, handled and processed in accordance with the provisions in RS CAC/RCP 1 and RS 285.

4.2 Recommended practices based on Good Agricultural Practices (GAP)

4.2.1 Planting

4.2.1.1 To be effective, pre-harvest control of aflatoxin contamination of peanuts shall take into consideration all the varied environmental and agronomic factors that influence pod and seed infection by the aflatoxin producing fungi, and aflatoxin production. It should be necessary to devise agricultural practices that by considering location and season of production.

4.2.1.2 Consider developing and maintaining a crop rotation schedule to avoid planting the groundnut in a field in two consecutive years. Cereals have been found to be particularly susceptible to *A. flavus*/*A. parasiticus* and they should not be used in rotation with groundnut. Crops such as potato, other vegetables, clover and alfalfa that are not hosts to *Aspergillus* species should be used in rotation to reduce the inoculum in the field.

4.2.1.3 In areas that are vulnerable to erosion, soil conservation practices shall be adopted in the interests of soil conservation.

4.2.1.4 Utilize the results of soil tests to determine if there is a need to apply fertilizer and/or soil conditioner to assure adequate soil pH and plant nutrition to avoid plant stress, especially during seed development, which makes peanuts more susceptible to fungal infestation.

4.2.1.5 Seed varieties developed for resistance to seed-infecting fungi and insect pests should be grown. Only seed varieties recommended for use in a particular area and season of a country should be planted in that particular area. As far as practical, crop planting should be timed to avoid high temperature and drought stress during the period of pod development and maturation and so that the crop matures at the end of the rainy season so that post-harvest field drying can be done under favourable conditions.

4.2.1.6 Irrigation, if feasible, is recommended to combat heat and drought stress.

4.2.1.7 Water used for irrigation and other purposes (e.g. preparation of pesticide sprays) should be of suitable quality for the intended use.

4.2.1.8 Avoid overcrowding of plants by maintaining the recommended row and intra-plant spacing for the varieties grown. Optimum plant populations shall be established bearing in mind that too high a population may lead to drought stress where rainfall may be below the optimum required in a growing season.

4.2.1.9 Excessive weed growth may deplete available soil moisture. Effective weed control by use of registered herbicides, or cultivation shall be done. Care should be taken during cultivation to avoid damage to pegs and pods.

4.2.1.10 Cultivation and crop protection practices that lower the incidence of soil insects, mites, and nematodes shall be done to help in reducing aflatoxin contamination. Insect damage and disease infection in the vicinity of the crop shall be minimized by proper use of registered insecticides, fungicides, and other appropriate practices within an integrated pest management program. Growers should consult with competent authorities to determine insects and other pests that are commonly found in their region that might attack peanuts causing them to be more susceptible to fungal infections that can lead to aflatoxin production.

4.2.2 Harvesting

4.2.2.1 Competent authorities shall take the lead in informing growers of the hazards associated with aflatoxin contamination of peanuts and how they may practice safe harvesting procedures to reduce the risk of contamination by fungi, microbes, and pests. Personnel to be involved in harvesting peanuts should be well trained in the personal hygienic and sanitary practices that shall be implemented throughout the harvesting season.

4.2.2.2 All equipment, which is to be used for harvesting and storage of crops shall be functional, clean, dry and free of insects and visible fungal growth before use and re-use. A breakdown during this critical period may cause peanut quality losses and enhance aflatoxin formation. Keep important spare parts available on the farm to minimize time loss from repairs.

4.2.2.3 Peanuts shall be harvested at full maturity, unless allowing the crop to continue to full maturity can subject it to extreme heat, rainfall, and drought conditions. It is very important to harvest the crop at optimum maturity, as excessive numbers of over-mature or very immature pods at harvest can be reflected in high levels of aflatoxin in the product; also delayed harvest of peanuts already infected may cause significant increase in aflatoxin content of the crop. A system by which the growing conditions of the farming crop is monitored (soil temperature and precipitation) may be very useful.

4.2.2.4 Individual plants that die from attack by pests, pathogens; such as *Sclerotium rolfsii* or *Fusarium* spp., and diseases, e.g. rosette virus, or insects, such as termites, earwigs, and false wireworms that caused damage to the pods; shall be harvested separately as their produce is likely to contain aflatoxin.

4.2.2.5 If peanuts have been irrigated, care should be taken to separately harvest peanuts that are beyond the reach of irrigation systems to avoid mixing aflatoxin-free peanuts with those that are potentially contaminated.

4.2.2.6 Damage to pods at the time of harvest shall be avoided as much as possible since this can lead to rapid invasion of the pods by *A. flavus*/*A. parasiticus*. Peanuts shall be handled as gently as possible and every effort made to minimize physical damage at all stages of harvesting and transportation procedures.

4.2.2.7 After harvest, pods shall be exposed for maximum rate of drying. This may be accomplished by turning the vines to leave the pods uppermost where they are away from the ground and exposed to sun and wind. Curing shall be completed as soon as possible to a safe water activity so as to prevent the growth of microorganisms, particularly moulds that produce aflatoxins. However, drying too rapidly may cause skin slippage and off-flavours in the peanut kernels. When curing by supplemental heat, excessive heat shall be avoided since this impairs the general quality of the peanuts, e.g. splitting of kernels after shelling. Close checks of moisture content/water activity of lots of farmer's stock peanuts shall be maintained.

4.2.2.8 Peanuts shall be dried in such a manner that damage to the peanuts is minimized and moisture levels are lower than those required to support mould growth during storage (generally less than 10%). This is necessary to prevent further growth of a number of fungal species in peanuts.

4.2.2.9 Freshly harvested peanuts shall be cleaned and sorted to remove damaged nuts, pre-shelled kernels, light pods and other foreign matter.

4.2.3 Drying

4.2.3.1 Immediately after harvest, determine moisture levels of the crop; where applicable, dry the crop to the moisture content recommended for storage of that crop.

4.2.3.2 Peanuts should be dried in such a manner that damage to the peanuts is minimized and moisture levels are lower than those required to support mould growth during storage (generally less than 10%). This is necessary to prevent further growth of a number of fungal species in peanuts.

4.2.4 Transportation

4.2.4.1 The nuts shall be moved to a suitable storage or to the processing area for immediate processing as soon as possible after harvesting or drying.

4.2.4.2 Containers (e.g. wagons, trucks) to be used for collecting and transporting the harvested peanuts from the farm to drying facilities or to storage facilities after drying, should be clean, dry, and free of insects, visible fungal growth and any contaminated material before use and re-use.

4.2.4.3 As necessary, transport containers shall be cleaned and disinfected before use and re-use and be suitable for the intended cargo. Only approved fumigants or insecticides shall be used. At unloading, the transport container shall be emptied of all cargo and cleaned as appropriate.

4.2.4.4 Consignments of peanuts shall be protected from all additional moisture by using covered or airtight containers or tarpaulins. Avoid temperature fluctuations that may cause condensation to form on the peanuts, which could lead to local moisture build-up and consequent fungal growth and aflatoxin formation.

4.2.4.5 Farmers' stock peanuts shall be screened for aflatoxin contamination to more accurately segregate for proper storage. Aflatoxin-free loads shall be segregated from loads with low levels of aflatoxin contamination, destined for subsequent processing and clean-up, and from loads that are highly contaminated.

4.2.4.6 Insect, bird, and rodent infestation during transportation shall be avoided by the use of insect and rodent proof containers or insect and rodent repellent chemical treatments provided they are approved for their intended use of the peanuts.

4.2.5 Storage

4.2.5.1 Post-harvest storage of peanuts is the phase that can contribute most to the aflatoxin problem in peanuts. For aflatoxin prevention in storage, mould development of the peanuts due to condensation or leaks in the warehouse should be prevented.

4.2.5.2 A properly ventilated warehouse with a good roof, preferably double sidewalls and a concrete floor are required to prevent rewetting of peanuts. Make sure that the storage facilities include dry, well-ventilated structures that provide protection from rain, drainage of ground water, protection from the entry of insects, rodents, and birds, and minimum temperature fluctuations. Painting warehouse roofs with white paint reduces solar heat load when compared to conventional galvanized material. The double roofing concept of installing a new roof over a defective, existing roof with an air space in-between the two roofs, has proven effective in controlling warehouse condensation.

4.2.5.3 Water activity, which varies with moisture content and temperature shall be carefully controlled during storage.

4.2.5.4 Uniform loading of the warehouse allows excessive heat and moisture to escape and reduces favourable areas for insect infestation. Stock piling of peanuts can cause heat build-up and moisture accumulation with resultant mould growth and aflatoxin contamination.

4.2.5.5 *A. flavus*/*A. parasiticus* cannot grow or produce aflatoxins at water activities less than 0.7; relative humidity shall be kept below 70 % and temperatures between 0 °C and 10 °C are optimal for minimizing deterioration and fungal growth during long time storage. Storage should be done at the lowest temperature possible consistent with ambient conditions but temperatures near freezing point should be avoided. Where possible peanuts should be aerated by circulation of air through the storage area to maintain proper and uniform temperature levels throughout the storage area.

4.2.5.6 The aflatoxin level in peanuts coming into a storage and peanuts going out of a storage shall be monitored, using appropriate sampling and testing programs.

4.2.5.7 For bagged peanuts, the storage shall be done in accordance with RS 264.

4.2.5.8 Measure of the temperature and visually check for evidence of mould growth of the stored peanuts shall be done at several fixed intervals during storage. The apparently infected portions of the peanuts shall be separated from the normal peanuts and not be used for food or feed production and the samples for analysis should be sent if possible.

4.2.5.9 Good 'housekeeping' procedures shall be used to minimize levels of insects and fungi in storage facilities. This should include the use of suitable traps, approved insecticides or fungicides and fumigants. Care shall be taken to select only those chemicals that cannot affect or cause harm to the peanuts.

4.2.5.10 Harvesting and storage procedures implemented each season should be documented by making notes of measurements (e.g. temperature, moisture, and humidity) and any deviation or changes from traditional practices. This information may be very useful for explaining the causes of fungal growth and aflatoxin formation during a particular crop year and help to avoid similar mistakes in the future.

4.3 Good Manufacturing Practice (GMP)

4.3.1 Receiving and shelling

4.3.1.1 Farmers' stock peanuts received at the shelling plant shall be inspected on arrival. The transport vehicle should be examined. If the vehicle is not fully enclosed, it should have a covering such as tarpaulin to keep out rain or other forms of water. The general appearance of the peanuts should be observed during the process of unloading. If the peanuts are wet to the touch, they shall not be mixed with peanuts in a bulk warehouse. The vehicle which contains the peanuts should be set aside until a decision is made for their disposal. If possible, remove a sample from each lot, separate the "loose shelled" kernels and shell the remainder for peanut grade observation before an acceptance decision is made.

4.3.1.2 Specifications for the purchase of peanuts intended for further processing shall include a maximum level for aflatoxin based in appropriate methods of analysis and a proper sampling plan.

4.3.1.3 Special precautions shall be taken to reject peanuts showing signs of insect damage or mould growth because of the danger of their containing aflatoxins. Aflatoxin test results shall be known before allowing lots of raw peanuts to be processed. Any lot of raw peanuts with unacceptable levels of aflatoxins, which cannot be reduced to permitted levels by the available sorting equipment, shall not be accepted.

4.3.1.4 The peanut processor shall satisfy himself that the supplier of shelled peanuts is able to control properly his own operations to assure that the finished product is within the maximum limit for aflatoxin.

4.3.1.5 All loose-shelled, damaged "Blows" and under-sized kernels shall be examined for possible presence of mould. If no external mould is visible, split the kernels to disclose possible hidden mould growth. Excessive mould or presence of mould resembling *A. flavus* warrants a chemical test for aflatoxin or rejection of the lot.

4.3.2 Sorting

4.3.2.1 Sorting is the final step for removing defective kernels. Where sorting belts are used, they shall be well lighted, with peanuts passing through no more than one layer deep, and operated at a speed which enables hand sorters to assure effective removal of foreign material and defective kernels. Sorting machines shall be adjusted as often as practicable against standards to assure removal of all defective kernels. Adjustment shall be checked frequently and regularly.

4.3.2.2 To remove mould-contaminated nuts effectively, sorting shall be performed before and after blanching and roasting. Blanching used in conjunction with gravity tables and manual or electronic sorting is very efficient in removing aflatoxin-contaminated kernels. Colour sorting, combined with blanching have been shown to reduce aflatoxin contamination by as much as 90 %.

4.3.2.3 Where splitting is part of the processing operation, nuts that resist splitting should be removed. The effectiveness of sorting techniques shall be checked by regular aflatoxin analyses of the sorted peanuts stream or of the finished product or both. This should be done frequently enough to ensure that the product is completely acceptable.

4.3.2.4 Defective (mouldy, discoloured, rancid, decayed, shrivelled, insect or otherwise damaged) kernels shall be bagged separately and tagged as unsuitable for human consumption. Containers of defective peanuts should be removed as soon as practicable from the processing area. Materials which carry the danger of contamination by aflatoxin or which are contaminated should be diverted to non-food uses.

4.3.2.5 Rejected peanuts from the sorting procedure shall be destroyed or segregated from edible products. If they are to be used for crushing, they shall be separately bagged and tagged as unsuitable for direct human consumption in their present state.

4.3.3 Packaging and storage of end product

4.3.3.1 Peanuts should be packed in clear appropriate bags. If using jute, ensure bags are not treated with mineral hydrocarbon based oils. All bags/cartons shall be lot identified to facilitate traceability of the product before being moved to controlled storage facilities or transported.

4.3.3.2 Peanuts that have been processed shall be stored and transported under such conditions as to maintain the integrity of the container and the product within it. Carriers shall be clean, dry, weatherproof, free from infestation, and sealed to prevent water, rodents or insects from reaching the peanuts.

4.3.3.3 Peanuts shall be loaded, held and unloaded in a manner that protects from damage or water. Well insulated carriers or refrigerated vehicles are recommended for transport when climatic conditions indicate such a need. Extreme care should be taken to prevent condensation when unloading peanuts from cold storage or from a refrigerated vehicle. In warm, humid weather, the groundnuts should be allowed to reach ambient temperature before exposure to external conditions. Peanuts that have been spilled are vulnerable to contamination and shall not be used for edible products.

4.4 Complementary management system

4.4.1 The Hazard Analysis Critical Control Point (HACCP) system is an all-encompassing integrated food safety management system should be used to identify and control hazards within the production and processing system. The general principles of HACCP have been described in RS 184.

4.4.2 When properly implemented, this system should result in a reduction of the levels of aflatoxins in peanuts. The use of HACCP as a food safety management system has many benefits over the types of management control systems in some segments of the food industry. At farm level there are many factors that influence the aflatoxin contamination of peanuts most of which are environmentally related, such as weather and insects, and these are difficult, if not impossible, to control. Particular attention should be paid to the soil population of the fungus, the health of seed material, soil moisture deficit stress at the pod formation and pod maturity stages, and rains at harvest. The critical control points often do not exist at the pre-harvest level. However, after harvesting, the critical control points may be identified for aflatoxins produced by fungi during drying and storage. For example, a critical control point could be at the end of the drying process and one critical limit would be the water content/water activity.

4.4.3 It is recommended that resources be directed to emphasizing the Good Agricultural Practices (GAPs) at the pre-harvest level and during drying and storage and Good Manufacturing Practices (GMPs) during the processing and distribution of various products. A HACCP system shall be built on sound GAPs and GMPs.

4.4.4 Integrated mycotoxin control programs should incorporate HACCP principles in the control of risks associated with mycotoxin contamination of foods and feeds. The implementation of HACCP principles minimizes aflatoxin contamination of peanuts through applications of preventive controls to the extent feasible in the production, handling storage and processing of each peanut crop.

PUBLIC REVIEW

Annex A
(normative)

Annex title

PUBLIC REVIEW

Annex B
(informative)

Which styles correspond to which element — Quick reference guide

PUBLIC REVIEW

Bibliography

- [1] RS 286: 2015 Prevention and reduction of aflatoxin contamination in peanuts— Code of practice, First edition

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