DIIS · DANISH INSTITUTE FOR INTERNATIONAL STUDIES
STRANDGADE 56 · 1401 COPENHAGEN K · DENMARK
TEL +45 32 69 87 87 · diis@diis.dk · www.diis.dk

INSTITUTIONAL CAPACITY FOR STANDARDS CONFORMITY ASSESSMENT: A CASE STUDY ON SPICES IN TANZANIA

Adam Akyoo and Evelyne Lazaro

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Danish Institute for International Studies, DIIS
Strandgade 56, DK-1401 Copenhagen, Denmark
Ph: +45 32 69 87 87
Fax: +45 32 69 87 00
E-mails: diis@diis.dk
Web: www.diis.dk
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Adam Akyoo is a PhD candidate at DIIS and the Department of Agricultural Economics and Agribusiness, Sokoine University of Agriculture, Morogoro/Tanzania.
Evelyne Lazaro is a senior research fellow at the Department of Agricultural Economics and Agribusiness, Sokoine University of Agriculture, Morogoro/Tanzania

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Abstract

Local capacity for standards conformity assessment is an important component in accessing export markets. In theory, it will lead to lowered compliance costs on the part of local exporters. Moreover, it may provide local exporters with the ability to contest unfavourable foreign test results and thus avoid unnecessary losses. This is important in cases where product contamination occurs outside their borders. This is however possible only where relevant local institutions are accredited and adequately capitalized in terms of laboratory facilities, testing equipment, and certification services.

Tanzania spices have four important market destinations – the domestic market, regional markets in Africa, the Asian market, and the EU market. The national standards that were formulated during late 1970s and 1980s address cleanliness and quality standards, and specify microbiological limits for various micro-organisms in spices. These standards are not observed in the local market due to lack of consumer demand for them and the absence of a deliberate industry drive to enforce them. This position weakens the possibility of using conformity to local standards as a stepping stone to international conformity. Regional markets in Africa and Asian export markets are absorbing spice imports regardless of their quality so issues of conformity assessment in these markets are not important.

EU market standards are concerned with food safety. In addition, organically-traded exports must be certified as such. For food safety the main tests demanded are for hazards like aflatoxins, pesticide residues, prohibited chemical dyes, heavy metals, as well as for Salmonella. Conformity assessment for these parameters entails investments in high performance liquid chromatograph, gas chromatograph, and atomic absorption spectrophotometer equipment, as well as other state-of –the-art laboratory facilities.

Local conformity assessment in relation to these standards is deficient in many ways. Different approaches are recommended to address this situation. Meeting challenges of international accreditation, harnessing scattered efforts for conformity assessment capacity through improved coordination of existing laboratories, and formulation of a national food safety policy are among the recommendations suggested.

List of Abbreviations

ESA European Spice Association
GCLA (Tanzania) Government Chemical Laboratory Agency
IEC International Electrochemical Commission
ISO International Standards Organisation
IMO International Marketecology Organisation
ITC International Trade Centre
LDC Least developed country
NFQCL (Tanzania) National Fish Quality Control Laboratory
TANCERT Tanzania Organic Certification Association
TBS Tanzania Bureau of Standards
TFDA Tanzania Food and Drugs Agency
TIRDO Tanzania Industrial Research and Development Organisation
TPRI (Tanzania) Tropical Pesticide Research Institute
UNDP United Nations Development Programme

Introduction

Safety standard compliance for agro-food exports is essential for gaining market access, especially to high value markets (Mitchell, 2003; Henson, 2003; Holleran *et al*,. 1999; Gogoe, 2003; Manarungsan *et al*,. 2004; Aloui and Kenny, 2004). This is the case for the spices sector as well (see Jaffee 2004 for the specific export standards required for entry into the EU and US markets). Conformity assessment refers to any procedure, direct or indirect, that is used to determine whether relevant requirements in technical regulations or standards are fulfilled (Stephenson, 1997). It covers four areas, namely; declaration of conformity (own assessment), testing of products (by independent laboratory), certification (by unbiased third party evaluator), and quality system registration (by quality system registrars). Each of the four areas covered by conformity assessment activities can be carried out at three different levels. The first level is assessment or evaluation, second is accreditation, and third is recognition. Assessment can be done by producers / manufacturers, laboratories, certifiers, and quality system registrars and involves comparing a product or process to a given standard (ibid).

Accreditation is a process of evaluating testing facilities for competence to perform specific tests using specified test methods (Stephenson, 1997). It involves evaluation and formal documentation of a facility's testing competence. It determines whether a particular testing facility has the required personnel qualifications, equipment and / or ability to perform tests. The presence of accredited facilities thus enhances the possibility of forging Mutual Recognition Agreements between internationally trading partners.

To attain recognition certification bodies must be accredited to ISO/IEC guide 62, 65, and 66; laboratories (testing and calibration) to ISO/IEC 17025; and inspection bodies to ISO/IEC 17020. The trend in accreditation is to establish a worldwide network of national or regional groupings of accreditation bodies which will, through Multilateral Agreements, ensure that the competence of certification bodies and laboratories are assessed on the same principle regardless of where in the world they are located. These assessments are based on the harmonized ISO standards (www.sanas.co.za).

The challenge of conformity assessment becomes clearer on recognition that acceptance of equivalence requires not merely the physical presence of institutions / organizations that are equipped to carry out necessary tests, inspections and certification. Requirement for these to be accredited may be more demanding than the need to put in place the required physical and human infrastructure (equipment and staff) for these tasks.

The EU and US are the major spice importers in the world. When intra-EU trade is included, the EU is currently the largest importer of spices (22 percent). Excluding intra-EU trade, the EU becomes the second largest importer (17 percent) behind the US. Among the biggest EU importing countries are Germany and Netherlands. Other major EU importers include France, Spain and UK. Japan accounts for 10 percent of world spice imports.[1]

LDC exports are focused primarily on the US and EU markets (ITC, 2003). As far as Tanzanian exports to high value markets are concerned (Khamis Issa Mohamed, *pers. comm.*, 2006), it is only cloves that are reportedly exported to Japan[2]. The overwhelming bulk of Tanzanian sales to high value markets go to the EU (mostly Germany and Switzerland). However, exports as a whole include substantial but undocumented levels of sales to Asian markets (various countries) and regional markets (various African countries).

Asian and African markets import Tanzania's conventional spices without clear quality criteria, whereas Tanzanian sales to the EU market are almost entirely of certified organic spices (Akyoo and Lazaro, 2007). EU official attention to these products relates to their conformity both with the EU's organic agricultural regulation and with rules on pesticide residue limits, Aflatoxin limits, and heavy metal contamination levels (Jaffee, 2004).

Two major challenges are thus critical in conforming to export standards in high value markets. The first is the need for producers to adhere to approved production methods (in the case of certified organic product)[3] and food safety requirements (for all products). The second is the need for producing countries to have adequate capacity to assess conformity for exportable food items with respect to importer country requirements. This paper evaluates prevailing local capacity to carry out standards conformity assessment for Tanzanian spice exports to the EU. The focus on the EU market is based on the fact that it is the major high value destination market for the crop.

[1] Domestic production of spices constitute 10%, >40% and <10% of domestic consumption in EU, US and Japan respectively (Jaffee, 2004).

[2] These are sold locally to M/s TAZOP Ltd (a private spice export company) by M/s Zanzibar State Trading Company (ZSTC) (the clove crop monopolist public company). The latter exports most of its clove product to various south-east Asian markets, the biggest buyer being Indonesia (Akyoo and Lazaro, 2007).

[3] Principles and rules for organic crop production and governing imports of organic product are laid down in EU Regulation 834/07 of 2007, replacing Regulation 2092/91 of 1991.

Methodology

This study is based on results arising from institutional mapping (which was done twice during the first and second quarters of 2005 and 2007 respectively) and on interviews with the main actors involved in either the spice industry and/or testing and certification (undertaken in November 2007 and February 2008). The 2005 institutional mapping was part of a wider preliminary exercise that aimed at establishing a list of all spice-related institutions in Dar es Salaam. Interviews were held with key personnel in the institutions in order to establish the roles played by each in the industry. At this time, no attempt was made to assess the level of safety-related investments each institution had made. The second mapping exercise occurred during June 2007, specifically to establish the capacity level of local institutions for testing hazards in foods. The aim at this stage was to get an indication of the types of hazards that each institution was able to detect / test, given its level of investment in equipment and other safety-related investments. The institutions surveyed include the Tanzania Bureau of Standards (TBS), the Tanzania Food and Drug Authority (TFDA), the Government Chemical Laboratory Agency (GCLA) and the Tanzania Industrial Research and Development Organization (TIRDO). TIRDO and TBS operate under the Ministry of Industry and Trade (MIT) whereas TFDA and GCLA are under the Ministry of Health and Social Welfare.

The follow-up interviews carried out in November 2007 and February 2008 were for gap filling and validation in respect of information that had been compiled previously. Interviews with the Dare es Salaam-based TANCERT (the sole local certification body for organics in the country), and the Tanzania Tropical Pesticide Research Institute (TPRI) laboratory in Arusha were also carried out during this time. Data on the National Fish Quality Control Laboratory (NFQCL) in Mwanza and the IMO (International Marketecology Organization) organic certification agency were solicited through lists of questions sent via e-mail. The authors also determined the actual food hazards in spices subject to mandatory testing before they are allowed entry into different export markets via a literature search, resulting in a list of food hazards presented in Annexes 1-4.

Export standards for spices

According to the Tanzanian National Trade Policy (URT, 2003a), local standards for any export oriented product should be aligned to match those of the country's major importers. Theoretically, this is in order that conformity with them may act as a stepping stone to conformity with international standards. Whilst this is a policy statement, its implementation, at least in the spice industry, is yet to take effect to date.

NATIONAL STANDARDS

Most national standards for spices were formulated during the late 1970s and 1980s. This is attributed to the fact that the local market for spices during the period was vibrant enough to merit their formulation and enforcement (Masaga, *pers. comm.*, 2007). Standards initially concerned quality attributes. Later, in the late 1980s, safety attributes were introduced via Tanzania Standard (TZS) 404: 1988, establishing microbiological specifications in spices (TBS, 1988).

During the late 1970s, five standards were formulated for black pepper (TZS 30: 1979), chillies and capsicums (TZS 31: 1979), curry powder (TZS 29: 1979), ginger (TZS 47: 1979), and turmeric (TZS 46: 1979). In the second half of 1980s three more standards came into being – clove (TZS 357: 1987), cardamom (TZS 358: 1987), and the earlier mentioned microbiological specification for spices (TZS 404: 1988). Meanwhile, in 1981, six other associated standards were established which related to acceptable sampling and analytical methods for microbiological analyses in general foodstuffs (TBS, 1979a, 1979b; and 1988).

Formulation of these national standards involved setting limits for several parameters including colour and size of a mature crop, odour and flavour, freedom from fungi, and insects, extraneous matter limits, limits for immature, marked or broken berries, fineness, and chemical requirement limits. These addressed five parameters, namely: moisture content, total ash, acid insoluble ash in hydrochloric acid, crude fibre, and non-volatile ether extract. Annex 1 summarizes the requirements on these attributes for black/white pepper and chillies and capsicums.

Microbiological limits, on the other hand, referred to five parameters, namely: Mesophilic aerobic bacteria, *Salmonella, Bacillus cereus, Clostridium perfringens,* and yeast and mould. The microbiological analysis was based on the establishment of total count of each micro-organism in a specified spice sample. The introduction of a microbiological specification standard for spices in 1988 (TZS 404: 1988) was in line with global trends in safety standards evolution for general food stuffs. According to Jaffee (2004), incorporation of health and hygiene specifications in commercial supply chains for spices started in the early 1990s. Before this period, it was only quality and cleanliness standards that were of concern. By implication, the publication of this standard meant that Tanzania was keeping pace with the level of safety standards in high value markets. For instance, zero tolerance to *Salmonella* was also established as a requirement in EU at this time.

Table 1(a) shows the acceptable micro-organism limits for different spice types under the standard.

Table 1(a): Limits of micro-organisms in spices (Tanzania national standards)

Spice type	Micro-organism type				
	Mesophilic aerobic bacteria (max. number per gm)	*Salmonella (max. number in 25 gms)*	*Bacillus cereus (max. number per gm)*	*Clostridium perfringens (max. number per gm)*	*Yeast and moulds (max. number per gm)*
B/pepper + w/pepper	10^5	0	10^3	5×10^2	10^4
Chillies + capsicums	10^5	0	10^3	5×10^2	10^3
Cardamom	10^4	0	10^3	5×10^2	10^2
Curry powder	10^5	0	10^3	5×10^2	10^3
Cloves	10^4	0	10^3	5×10^2	10^3
Ginger	10^5	0	10^3	5×10^2	17×10^3
Turmeric	10^6	0	10^3	5×10^2	10^3

Source: TBS (1988)

Table 1(b): General microbiological specification - Germany & Netherlands

Parameter	Standard Value	Danger Value
Germany		
Total Aerobic Bacteria*	$1x10^5/g$	$1x10^6/g$
E-coli	Absent	Absent
Bacillus cereus	$1x10^4/g$	$1x10^5/g$
Staphylococcus aureus	$1x10^2/g$	$1x10^3/g$
Salmonella	Absent in 25g.	Absent in 25g.
Netherlands		
Bacillus Cereus	Absent in 25g	Danger values similar to those of Germany.
Escherichia Coli	Absent in 25g	
Clostridum perfringens	Absent in 25g	
Staphylococus aureus	Absent in 25g	
Salmonella	Absent in 25g	
Total Aerobic Bacteria	$1x10^6/g$	
Yeast and Mould	$1x10^3/g$	
Coliform	$1x10^2/g$	

*Total aerobic bacteria parameter in Table 1(b) is the same parameter as Mesophilic aerobic bacteria in Table 1(a).
Source: Kithu (2001).

In reality, even at this time Tanzanian standards fell short of those applied in some of the major European spice markets, such as Germany and Netherlands. Table 1(b) shows the general acceptable microbiological limits in these markets.

Differences in standards' stringency between member states within the EU on identical parameters for a particular product as depicted in Table 1(b) have always impacted negatively on LDCs' compliance efforts.

EU FOOD SAFETY STANDARDS AND SPICES

There are no specific food safety standards for spices in the EU (Jaffee, 2004). These are instead derived from general food standards. Annex 2 summarizes most of the standards which are currently applicable in the European Union (EU) and provides details on what testing equipment is necessary in relation to them. A brief discussion of each standard is presented below. All technical details, unless otherwise cited, are from Jaffee (2004).

Cleanliness

The major concern here is the existence of extraneous material and mould in spices. Tolerance limits are set on the assumption that it is not economically practical to grow, harvest, or process food raw materials that are totally defect free. Maximum levels of natural or unavoidable defects are thus established instead.

The cleanliness standards given in Annex 2 are actually the unified American Spice Trade Association / US Food and Drug Administration (ASTA/FDA) established limits. This is due to the fact that European Spice Association (ESA) specifications are yet to become uniform despite their inception in the 1990s. However, ASTA/FDA standards were adopted by EU countries even before introduction of the ESA standards. Moreover, there seems to be a fair degree of compatibility between the two.

Aflatoxins

The limits shown in Annex 2 were established as a result of the 2001 amendment of the EU Commission's 1997 specific regulation on Aflatoxin contamination in spices. In the amendment, aflatoxins were described as potent liver carcinogens in animals and hence probable human carcinogens. Aflatoxin B1, in particular, was branded a genotoxic carcinogen for which there is no lower threshold triggering harmful effects and therefore no admissible daily intake could be set (CEC, 2001). The EU Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) held that aflatoxin contamination in spices should be reduced to the lowest level that is technologically possible.

Minimum Residue Levels (MRLs)

There are no dedicated MRLs for spices at the EU level. However, individual member states have set dedicated spice MRLs, particularly Germany and Spain which between them have about 30-40 official MRLs for spices. In Spain for example, the limit for Ethion (an insecticide used in chillies) is set at 0.1 ppm (parts per million), and for Carbaryl in fresh pepper at 5 mg/kg (see Annex 4 for details). However, the requirement to use only chemicals that are registered as acceptable pesticides is akin to a standard at the EU level.

Two complications in relation to MRLs for spices from the developing world have surfaced. A first complication relates to the absence of Extraneous Maximum Residue Limits (EMRLs) for persistent pesticides which are still found in soil and water though they are no longer in use. This complication becomes more serious when the list of accepted pesticides for use is frequently updated whilst their presence in water and soil persists over a longer period. A second complication concerns the magnification effect of pesticide residues in dried chillies due to dehydration. Proposals by some spice exporters from developing (especially India) countries and least developed countries to institute an adjustment factor of 10 to correct for this anomaly are yet to receive positive consideration in importing industrial countries (Jaffee, 2004).

Artificial colorants and additives

Attention has so far been on the presence in spices of the prohibited red dye Sudan 1 and chemical dye Para red. They are both believed to be carcinogenic. For instance, Sudan 1 dye presence in Indian spice consignments was posted on the EU's Rapid Alert System of Food and Feed in May 2003 (Jaffee, 2004). A Para red dye alert was raised on April 21st, 2005 following its detection in some spice seasonings in the UK (*Guardian Unlimited*, 3.5.2005). Both cases resulted in product recalls and withdrawal from supermarkets.

Pathogens

The major concern is with the presence of *Salmonella* bacteria contamination in spices. Individual member EU countries have specific concerns on this front (see Table 1(b)). For example, whilst Netherlands observes zero tolerance to both *Bacillus cereus* and *Staphylococcus aureus* in general foodstuffs, tolerance limits for the same hazards in Germany are $1x10^4$ per gram and $1x10^2$ per gram, respectively.

Heavy metals

Reference is sometimes made to spice contamination with Mercury, Lead, and Cadmium (Henson, 2003; Jaffee, 2004). All EU countries appear to have specified MRLs for Lead as well as for Arsenic, Copper, and Zinc as shown in Annex 2.

Capacity for food safety standards-related conformity assessment in Tanzania

FOOD HAZARDS TESTING

Summarizing Annex 2, food safety-related standards conformity assessment for the EU market would necessitate investment in:

(a) Detection of Aflatoxins - here, investment in high performance liquid chromatograph equipment is entailed.
(b) Detection of heavy metals - the presence of atomic absorption spectrophotometer equipment is required.
(c) Detection of pesticide residues - gas chromatograph equipment is required.
(d) Detection of microbial pathogen - and specifically for contamination with *Salmonella* bacteria – diverse laboratory equipment is required as shown in Table 2 (TFDA Laboratory Services Directorate, referring to a testing laboratory that handles less than 10 samples per day).

Table 2: Requisite laboratory equipment for Salmonella testing

Name of equipment	Capacity of the equipment	Number of units required	Unit cost (USD)	Total investment cost (USD)
Incubator	400cc	3	6,000	18,000
Water bath	300cc	1	2,000	2,000
Autoclave	600cc	1	10,000	10,000
Oven	400cc	1	4,500	4,500
Stomacher	--	1	3,000	3,000
Biological safety cabinet	--	1	15,000	15,000
Glassware	variable	variable	variable	30/piece
Total				**52,530**

Source: Laboratory Services Directorate, TFDA

If testing for anaerobic bacteria like *Bacillus cereus* and *Clostridium perfrigens,* such a laboratory would be required to make additional investments to acquire special incubators, special growth media, and an anaerobic jar. This could amount to an extra USD 10,000 worth of investment capital.

Learning from the example of India (the largest spice producer and consumer globally, see http://www.caudilweb.com/triplestandards/en/Topic5aspx), the above safety-related investments are possible when both industry and government collaborate effectively (Jaffee, 2004). For instance, over the period 1991 – 2003, total safety-related investment in the Indian spice industry amounted to USD 14.5 million with three quarters of this being undertaken by the industry itself and one quarter by the public Spice Board. Investment in laboratories alone amounted to USD 540,000. 45 percent of these costs were met through technical assistance from UNDP and ITC. The rest was from the industry and government (via the Spice Board). Meeting such challenges in the Tanzanian context, with a very weak institutional set up and minimal public involvement in the industry, is bound to be difficult.

TESTING CAPACITY IN TANZANIA

No dedicated investment on to laboratory testing equipment for safety-related risks for spices has been undertaken by either the private or public sectors in Tanzania. This is explained by the small size of the industry itself, the small size of individual smallholder spice farmers' and traders' scales of operation, and the change of direction of destination markets for spices, especially for clove which is the major spice crop. If Tanzanian clove had continued to be traded in high value markets (as was the case before the turn to the Asian market, Akyoo and Lazaro, 2007), the position might be different today. Given its value, the volume traded, and the significant (Zanzibar) government involvement in its marketing, it was probably the only spice crop that could justify the involved capital expenditure. The prevalence of markets that demand no strict adherence to safety standards is, inversely, a significant disincentive for the sub-sector to engage in such costly investments.

Nonetheless, there are investments by the public sector that can potentially serve a variety of agro-food export industries, including spices. The authors' survey revealed that TBS, TFDA, TIRDO, and GCLA have all undertaken investments in this regard. These organizations however prioritize testing of locally processed products and imports. The capacities of each of these organizations are summarised in Tables 3(a) and 3(b) below and then discussed in turn. Table 3(a) summarises physical capacity in terms of available equipment whereas Table 3(b) summarises personnel capacity in respect of professional staff for each laboratory.

Table 3(a): Summary of physical capacity for food safety testing by institution (2008)

Hazard	Test	Equipment necessary	Institutions having the equipment	Accred. status	Cost of test (if accredited) USD
Salmonella	Laboratory test	Incubator, water bath, autoclave, oven, stomacher, biological safety cabinet	TBS, TFDA, TIRDO, GCLA, NFQCL	NFQCL only	NFQCL is yet to set fees for services rendered to outside customers
Aflatoxins	High performance liquid chromato-graphy (HPLC)	High performance liquid chromatograph	TBS, TFDA, TIRDO, GCLA	None	N/A
Pesticide residues	Gas chromato-graphy (GC)	Gas chromatograph	TFDA, GCLA	None	N/A
Heavy metals	Atomic absorption spectrophotometry (AAS)	Atomic absorption spectrophotometer	TBS, TFDA, TIRDO, GCLA	None	N/A
Artificial colorants and chemical dyes	High performance liquid chromatography (HPLC)	High performance liquid chroma-tograph (different certified reference material from those for aflatoxins)	TBS, TFDA, TIRDO, GCLA	None	In addition to lacking accreditation, no laboratory tests for these in Tanzania

Source: Authors' survey data, 2005-08

Table 3(b) Summary of professional capacity for food safety testing by institution (2008)

Institution	Type of laboratory	Professional capacity		Remarks
		Education level	Discipline	
TFDA	Chemistry	1 MSc 1 MSc 1 MSc 1 Diploma	Food scientist. Engineer. Chemist. Technician.	2 additional BSc level food scientists required.
	Food microbiology	1 BSc 1 Diploma	Food scientist. Technician.	No additional personnel required
TBS	Chemistry	1 MSc 3 BSc 2 diplomas	Chemist. Food scientist. Technicians.	No additional workforce required.
	Microbiology	1 MSc 2 BSc 1 diploma	Microbiologist. Food scientist. Technician.	No additional personnel required
GCLA	Food	1 MSc 1 BSc 4 Diplomas	Food scientist. Food scientist. Technicians.	2 additional BSc level food scientists required.
	Microbiology	1 MSc* 2 BSc 2 Diplomas	Microbiologist. Microbiologists. Technicians.	2 additional BSc level microbiologist required
TIRDO	Food microbiology	1 BSc 1 BSc 4 Diplomas	Microbiologist. Food scientist. Technicians.	No additional personnel requirement in the short run.
NFQCL	Fish quality assurance	2 MSc + 1BSc 2 BSc 3 Diplomas + 2 certificates	Microbiologists. Food scientists. Technologists / Technicians.	Unspecified staff deficit reported
TPRI	Pesticide residue	1 PhD 1 PhD* 1 BSc 3 Diplomas	Chemist. Chemist. Engineer. Technicians.	4 additional PhD chemists + 4 technicians.
	Quality assurance	2 MSc 1 MSc* 1 BSc 2 Diplomas	Chemists. Chemist. Chemist. Technicians.	2 additional PhD chemists, 1 MSc or BSc chemist + 6 technicians required.

* On-going programme.
Source: Author's survey data 2007-08.

Tanzania Food and Drugs Authority (TFDA)

TFDA operates under the Ministry of Health and Social Welfare and is responsible for overseeing the quality / safety of food, drugs, and related products. It was established under the Food and Drugs Act No. 1 of 2003 and started operations in July 2003. It issues certificates of registration subject to laboratory tests.

Certification is provided on a consignment basis and the focus has mainly been on packed processed foodstuffs. Spices have not been among the products that have been certified by TFDA (Ngendabanka, *pers. comm.*, 2005). The argument is that, for a product to qualify for registration, its quality should remain unchanged over time and spices do not qualify on this basis, hence their exclusion.

The TFDA laboratory, as of June 2007, was under major renovation. The available equipment could only test for microbial pathogen contamination in food. However, customers requiring other tests for their samples were accepted and the samples were taken to the GCLA. The TFDA fee structure for various tests is summarised in Table 4 below.

Table 4: TFDA laboratory toll fee structure

Type of food hazard	**Fees chargeable** (USD) per sample	**Remarks**
Mycotoxins / aflatoxins*	30	Contracted out to GCLA
Microbial pathogens	50	Undertaken by TFDA
Heavy metals***	20 @ metal	Contracted out to GCLA
Pesticide residues**	45 @ pesticide	Contracted out to GCLA

Source: Authors' survey data, 2007
* As of November 2007, TFDA had already procured one High Performance lLquid Chromatograph set (estimated cost over USD 90,000), reportedly already working.
** In November, 2007 the presence of a Gas Chromatograph l (estimated cost over USD 66,000) was reported but it was yet to be used.
*** Procurement of an Atomic Absorption Spectrophotometer[4] (estimated cost over USD 110,000) was confirmed during the February 2008 survey.

[4] Procurement of lab equipment by TFDA has so far been financed separately by WHO, Global Fund, Clinton 4x4 Initiative, UNICEF, and the International Atomic Energy Agency.

A problem is that TFDA currently lacks accreditation[5] to register the results of its tests. TFDA is looking forward to applying for accreditation during 2008 after the new laboratory building is completed. Preparation of quality manuals (as per ISO/IEC 17025) was reported to have been completed.

Levels of professional capacity at TFDA suffice its current operations[6]. The personnel profile in the chemistry laboratory is made up of three MSc holders (a food scientist, an engineer and a chemist) and one Diploma holder (a technician). Recruitment of two BSc holders (both food technologists) is required to improve the capacity but was reported to be limited by budgetary allocations (Hipoliti, *pers. comm.* 2008). The food microbiology laboratory is staffed with only one BSc holder (a food technologist / scientist) and one Diploma holder (a technologist / technician). An additional two food technologists and one laboratory technologist / technician are required to improve the capacity.

Tanzania Bureau of Standards (TBS)

TBS is the sole standards body in Tanzania and was established under the Standards Act No. 3 of 1975, subsequently amended by Act No.1 of 1977. Being a national standards body, TBS is a member of ISO. It is the national enquiry point for all matters pertaining to standardization and ISO (Mneney, *pers. comm.* 2007). In the process of formulating standards, technical committees are established for which TBS forms the secretariat. Currently, there are 30 technical committees each comprising 12 members. Committee members are key stakeholders in the respective industries for which standards are to be formulated. Spices and Condiments is one of the technical committees of TBS and the national standards on spices are a result of its work.

TBS's Laboratory can only handle tests for microbial pathogen presence and some aspects of heavy metal contamination. In the latter case, detection is only for Lead contamination whereas

[5] Accreditation involves a multi-stage process that include; documentation → application → documents review→ feedback → pre-assessment → initial assessment → recommendation → accreditation. In this regard, TBS's metrology (scientific measurement) and microbiology laboratories are currently SANAS accredited (although the latter is not yet accredited for *Salmonella*). SANAS (South Africa National Accreditation Service) is a member of both the International Laboratory Accreditation Cooperation and the International Accreditation Forum and it is recognized by the EU. TBS's food and chemistry laboratory is at the pre-assessment stage; and TIRDO's microbiology and chemistry lab is at the pre-assessment stage. DANIDA is financing the on-going accreditation applications for all five laboratories.

[6] Following procurement of HPLC and GCMS, TFDA laboratory staff were trained in Germany for 3 months to enhance their ability to operate the equipment.

Mercury testing is hampered by lack of requisite kits. Capacity to test for Cadmium and other heavy metals is doubtful as it was reported that such tests have not been attempted.

High Performance Liquid Chromatograph (HPLC) equipment to test for mycotoxins / aflatoxins was procured in October, 2007. Gas Chromatograph equipment for pesticide residue (MRLs) testing is completely lacking. TBS laboratory's incapacity is reported to be more in regard to lack of necessary equipment than lack of trained human resource.

TBS's microbiology laboratory is staffed with one MSc holder (a food microbiologist), two BSc holders (food technologists / scientists) and one Diploma holder laboratory technician. No personnel deficit was reported at the time of survey. The chemistry laboratory had one MSc holder (a chemist), three BSc holders (food technologists / scientists), and two Diploma holder technicians. Likewise, this workforce was considered sufficient at the time of survey. Estimated toll fees for various tests at the TBS laboratory are shown in Table 5 below.

Table 5: Estimated toll fee structure for TBS laboratory

Hazard type	**Toll fees (TZS) (Exch. 1,100TZS ≡ 1USD)**	**Remarks**
Mycotoxins / aflatoxins	60,000 (USD 54.5)	Not yet undertaken. Testing to start following procurement of HPCL
Microbial pathogens	12,000 (USD 10.9) @ parameter*	Currently undertaken
Heavy metals	20,000-25,000 (USD 18.18-22.72)	Partly undertaken
Pesticides	-	Not yet undertaken

*There are normally 5 parameters in food testing [see Table 1(a)]
Source: Survey data, 2007.

TBS' microbiological laboratory became accredited by SANAS (see note 5) in December 2007 for E. coli, total plate count, and Coliform tests (Mneney, *pers. comm.* 2007) *Salmonella* testing was not then accredited due to the absence of a biological safety cabinet. The cabinet has now been procured, thus an application for accreditation with respect to *Salmonella* testing is now imminent.

Tanzania Industrial Research and Development Organization (TIRDO)

TIRDO is a parastatal organization which was established by Act No.5 of 1979 and became operational in April 1979. It was set up for the purpose of conducting industrial research and providing consultancy services to industry. TIRDO has three laboratory facilities covering food microbiology, energy and environment. The microbiology laboratory is capable of testing for *Salmonella, Vibrio cholera*, *Staphylococcus aureus*, *Clostridium spp.*, and *Escherichia coli* (Massawe, *person. comm.*, 2007).

TIRDO has HPCL equipment for aflatoxin testing but this was not in working order at the time of the survey due to software problems. An AAS for heavy metal testing has been procured but was not yet in use at the time of survey. The GC equipment is lacking so pesticide limits cannot be tested.

TIRDO's microbiology laboratory is planning to apply for SANAS accreditation[7]. All the necessary quality manuals are ready and a pre-assessment has already been done. The laboratory is staffed with one microbiologist, one food technologist, and four technicians. This workforce was reported to be adequate given the number of customers currently being served.

Government Chemist Laboratory Agency (GCLA)

This is the most sophisticated laboratory facility in the country in terms of food hazards testing. It is well equipped to test for all of the four types of hazards of concern, in addition to antibiotic residues. It is also the sole laboratory facility in East and Central Africa that is capable of testing for Polychlorinated biphenyls (PCBs) (Masambu, *pers. comm.*, 2007). However, Tanzanian exporters tend not to use this local facility, first, because of delays in delivery of test results which often translates into loss of sales; and second, the laboratory, like those of TIRDO, TFDA and TBS, is not accredited, so test results would not be recognized in the EU market.

The existence of delays is conceded by GCLA but said to be an inevitable consequence of the necessity of sourcing most of its certified reference material from abroad. For instance, the process of obtaining certified reference material for aflatoxin from Europe may take up to two months. At times, given the toxic nature of aflatoxins, foreign suppliers may even decide to come and verify the need for reference materials on the ground of fear of possible misuse, as aflatoxins are also potent raw materials for biological weaponry. If this occurs, further delays are likely to be encountered.

[7] Normally the total cost of completing an accreditation exercise, for any laboratory, amounts to about USD 9000. However, any applicant has to be cautious when applying because non-compliance at any stage will render the whole exercise null and void and thus requiring a fresh start after the anomaly(ies) are corrected. A fresh start attracts the same costs as initially, so many laboratories prefer to go through the pre-assessment stage before actual initial assessment to avoid such possible losses.

GLCA has also applied for SANAS accreditation[8] and is now past the first stage, i.e. registration for accreditation. In the first phase of evaluation, the current buildings were disqualified, thus new buildings are now under construction. The fee structure for GCLA test services on spices and herbs is as shown in table 6 below.

Table 6: GCLA fee structure for spices and herbs

Type of Analysis	Cost (USD)	Remarks
Moisture content	8.00	Undertaken
Heavy metals	23.00 @ metal	Undertaken
Microbiological examination	55.00	Mostly sent to TFDA
Aflatoxins	30.00	Undertaken
Extraneous matter	5.00	Undertaken

Source: Ministry of Health's price list for GLCA (URT, 2003b).

GCLA is staffed with a total of five food technologists /microbiologists (one MSc holder, one undergoing MSc degree training, and 3 BSc holders). Three of the BSc holders are serving in Mwanza branch. There are also a total of six technicians (four in the food laboratory and two in the microbiology laboratory). At the moment, there is a deficit of two BSc-holding food technologists and two BSc-holding microbiologists, to serve in the food and microbiology laboratories respectively.

Tropical Pesticide Research Institute (TPRI)

TPRI was established in 1979 by an Act of Parliament. It is under the Ministry of Agriculture, Food Security, and Cooperatives (MAFSC). Currently, it has three departments namely; research, technical services, and administration. It has two laboratories that fall under the analytical section of the technical services department (Hangali, *pers. comm.*, 2008). The laboratories are (i) a pesticide residue laboratory and (ii) a quality assurance and analytical laboratory.

TPRI is yet to start-off on food testing activities due to two major reasons. Firstly, its laboratories are ill-equipped for food hazards testing. The pesticide residue laboratory is deficient in equipment, thus MRLs are not tested as a GC is lacking. The available AAS can only detect Copper,

[8] Government Chemists in Tanzania and Uganda are applying for SANAS accreditation, whilst that in Kenya has opted for UKAS (United Kingdom Accreditation Service).

Chromium, Zinc and Manganese but not other heavy metals including Cadmium, Lead, and Mercury.

Secondly, TPRI is specialized in pesticide formulation, so food testing is outside its main agenda. Pesticide formulation activities involve testing pesticides composition against given specifications for ensuring their authenticity, effectiveness, and proper usage. The quality assurance laboratory is thus equipped with working HPLC, AAS, and GCs. These equipment are not however used for food testing for fear of cross contamination of results.

TPRI's personnel profile also reflects the organization's specialisation. The entire staff (see Table 3(b)) is made up of chemists and there are no food microbiologists or technologists. However, judging from the long experience with pesticides in general and the available personnel, TPRI could be a strong centre for MRLs testing in future if the proper equipment was available.

On the other hand, according to the analyst in-charge, current recruitment priorities are for more chemists, including four with PhDs (an analytical chemist, an environmental chemist, a natural products chemist, and a toxicologist) and four diploma level technicians for the pesticide residue laboratory, as well as three additional analytical chemists (two of them at PhD level) and four Diploma level technicians for the quality assurance laboratory.

National Fish Quality Control Laboratory (NFQCL)

The NFQCL is situated at Nyegezi in Mwanza city, north western Tanzania. It is owned by the government and operates under the Ministry of Natural Resources and Tourism. It is the government-designated fish quality control laboratory and caters specifically for the Lake Victoria Nile Perch industry. Fish quality / safety failures in the past resulted in an EU import ban of Nile Perch from the lake in 1997. Recent government investment in the laboratory is thus a response to that shock.

NFQCL food testing capacity is summarized in Table 7(a) A notable feature of this capacity is its achievement of SANAS accreditation for *Salmonella* testing. This is the only laboratory in the country that has so far been accredited for testing this parameter. The lab however lacks capacity in testing for other food hazards - pesticide residues, heavy metals, Aflatoxins, and chemical dyes and colorants.

NFQCL's personnel profile is summarised in Table 7 (b). Deficits of personnel in each category were conceded, but no precise figures were given.

Table 7(a): Summary of NFQCL capacity for food safety sconformity assessment

Hazard	Test	Equipment necessary	Whether equip. held /not held	Accreditation status	Cost of test
Salmonella	*Detection*	*Safety Cabinet Autoclaves*	*Held*	*Already achieved*	*Not established*
Aflatoxins	*Elisa*	*HPLC- MS/MS*	*Not held*	*Not yet*	*Not established*
Pesticide residues	*Detection*	*GC GC-MS/MS*	*Not held*	*Not yet*	*Not established*
Heavy metals	*Detection*	*AAS*	*Not held*	*Not yet*	*Not established*
Artificial colorants and chemical dyes	*Detection*	*GC HPLC-MS/MS*	*Not held*	*Not yet*	*Not established*

Source: Authors' survey data 2008

Table 7 (b): NFQCL personnel profile, February 2008

Category	Number of employees with professional qualifications			
	MSc	BSc	Diploma	Certificate
Food microbiologists	2	1	-	-
Food technologists	-	2	3	-
Laboratory technicians /technologists	-	-	-	2
Other technical staff (Secretary)	-	-	1	-

Source: Author's survey data, 2008

In the short term, NFQCL's objective is to provide laboratory analytical services on fish and fishery products only. In the long run, the laboratory plans to offer such services for other food stuffs plus intensive involvement in research activities.

ORGANIC CERTIFICATION

Organic certification for export destined spices is currently carried out by a Swiss company, IMO (Akyoo and Lazaro, 2007). Initially, all work including inspection, was carried out by this agency.

Lately, most of the activities (especially inspection) have been externalized to staff from the local certification agency TANCERT[9] (Tanzania Organic Certification Association). This has been the trend in all of the East African countries in matters pertaining to organic certification (Rundgren, 2007). But certification itself is still performed by IMO.

Costs for foreign-based certification are generally considered to be high, with charges per individual farmer ranging from USD 10 to USD 100 for a typical Internal Control System (ICS) of 500 farmers and very small ICS groups respectively (ibid). The average cost of certifying an individual farmer as calculated from Tanzanian exporters' data ranges from USD 9.3 to USD 35.3 (authors' survey, 2006-07). Accreditation of local agencies has always been thought of as a feasible way to reduce these costs.

However, the observed trend is that foreign-based certifying agents establish regional representation and forge even closer cooperation with local bodies, rather than the latter obtaining accreditation in their own right. Conflicts of interest between the two camps (accreditation of a local body for certification purposes possibly means replacing a foreign-based one) may slow down the process.

TANCERT describes itself as a private organization of farmers that was established in 2003. It was founded by NGOs interested in organic related activities and registered under the 1954 Societies Ordinance. It inspects and/or certifies spices as per demand. It is able to inspect for organic standards for almost any market on the globe through its contract / cooperation with IMO. However it plans to fully replace IMO in two years time (Mtama, *pers. comm.* 2007). Its accreditation application for international organic certification is being audited by IOAS (International Organic Accreditation Services)[10]. TANCERT claims that local exporters are incurring high certification costs due to the absence of an internationally accredited local certifier. TANCERT is currently authorized only to inspect to regional organic standards. IMO and TANCERT fee structures for their different activities are shown in table 8(a – c).

[9] Besides IMO, TANCERT has cooperation agreements with other organic certifying agencies that are operating in Tanzania. These include CERES (Germany) and BIOINSPEKTA (Switzerland). However, IMO is the major player in the spices sub-sector. Other agencies that are operating in Tanzania but are yet to enter into cooperation agreement with TANCERT include ECOCERT (France / Germany) and SKAL (Netherlands).

[10] This will not automatically qualify it for recognition by the EU as an authorized certification body however. Under EU regulation 834/07 this is subject to a further assessment by the EU Commission.

Table 8: IMO and TANCERT fees schedules (regrouped for comparison)

(a): Application fees

Category	Level in USD or equivalent (TANCERT)	Level in USD or equivalent (IMO)	Explanations (TANCERT)	Explanations (IMO)
Small individual farms	30	--	The fees are paid in a lump sum when applicants submit the forms to TANCERT. The application fee is not refundable.	No application fee. Prepayment of inspection costs required before start of inspection.
Society/ Association/Farm group	30	--		
Operator with contracted farmers	25	--		
Processor at small scale	30	--		
Processor at factory level	50	--		
Big farms	50	--		

(b): Inspection fees

Daily fees

Category	Level in USD or equivalent domestic market (TANCERT)	Level in USD or equivalent domestic market (IMO)	Explanations (TANCERT)	Explanations (IMO)
Small individual farms	100	€ 250 ($350)	All levels are rated per day of inspection work.	Depending on the task, field re-inspection €95 ($133) conducted by junior inspector, €160 ($224) conducted by senior inspector, €370 ($518) for evaluation of ICS.
Society/ Association/Farm group	120	€95 to €370 ($133 - $518)		
Operator with contracted farmers	150	€95 to €377 ($133 - $527.8)		
Processor at small scale	100	€250 ($350)		
Processor at factory level	150	€250 ($350)		
Big farms	150	€250 ($350)		

(c): Certification fees

Category	Domestic and regional market in USD or equivalent (TANCERT)	Domestic and regional market in USD or equivalent (IMO)	Description (TANCERT)	Description (IMO)
Small individual farms	50	€160 to €830 ($224 - $1,162)	Per working day	Certification fee (lump sum payment) according to standard, to be paid for each standard certified against.
Society/ Association/Farm group	80	€160 to €830 ($224 - $1,162)		
Operator with contracted farmers	100	€160 to €830 ($224 - $1,162)		
Processor at small scale	60	€160 to €830 ($224 - $1,162)		
Processor at factory level	100	€160 to €830 ($224 - $1,162)		
Big farms	100	€160 to €830 ($224 - $1,162)		

*IMO inspection and certification fees in Africa
Source: TANCERT, 2008; IMO, 2008, pers. communications

Notes:
Other fees: The operator will meet transport and accommodation costs for the inspector including the overhead costs during inspection like photocopying, printing. This will be worked out and agreed with TANCERT before an inspector is assigned to the inspection work. For IMO, travel costs and accommodation during inspection have to be reimbursed based on actual expenditure.

(€1 = USD 1.4)

From the details of Tables 8(a-c) above, marked differences in inspection and certification costs can be observed between the IMO and TANCERT. However, it is difficult to compare the two on account of TANCERT's lack of international accreditation. Arguably, given the fact that TANCERT's jurisdiction is restricted to the domestic and regional markets whereas IMO caters for high value markets, such differences might be expected.

However, an ongoing point of contention concerns IMO's different charges for field inspections when these are done by junior or senior inspectors respectively. This was also brought up by spice exporting companies in Zanzibar (Akyoo and Lazaro, 2007). The complaint is that the decision to send a junior or a senior inspector is the prerogative of the certifying agency, a situation which can give rise to rent seeking by the agency. Since both scenarios (use of junior or senior inspector) lead to similar outcomes, the different charges (USD133 vs. USD 224 per day) can hardly be justified.

SUMMING UP

From the foregoing discussion, the following can be observed:

(i) That, while there are no dedicated testing facilities for spices, there are a number of multi-functional testing facilities in Tanzania. However, none of these facilities performed any tests for spices. This is partly because of specialization by some facilities in other commodities, and partly because exporters of spices avoid using these facilities due to inefficiency.

(ii) At the same time, there seems to be a lack of a coordinated approach to capacity for food testing generally. This is reflected in the replication of efforts in equipment acquisition by laboratories under different ministries' ownership and overlapping mandates between the laboratories that are legally established. Many stakeholders attribute this to the absence of a food safety policy in the country. This results in underutilization of sophisticated and often very expensive equipment.

(iii) Some critical equipment is not yet working, out of order, or not accredited for use. This is partly an indication of inadequate technical capacity to operate the equipment. Levels of professionally qualified staff for food safety testing is generally not the main constraint, but specialized training to carry out specific tests, operation and maintenance of equipment is still needed. A major problem would appear to be dispersal of capacity between laboratories.

(iv) For organics, IMO has a *de facto* monopoly in Tanzania although TANCERT may be an alternative in the future.

Institutional conformity assessment capacity challenges for spices: Concluding Remarks

Despite the existence of multi-functional testing facilities in Tanzania, local exporters of spices to the EU are not among the users of these facilities. Tests/certification are invariably carried out abroad or by foreign actors, usually through the assistance of exporters' sister / partner companies (Akyoo and Lazaro, 2007). This can be explained by the following:

(i) Delays in local service delivery due to inefficiencies in the procurement of necessary laboratory reference materials for various tests, or to laboratory equipment being unusable.[11]

(ii) Existence of testing facilities abroad which are more efficient and convenient to local exporters (as they are not made to pay for tests directly upfront and in some cases appear to pay only for dispatch of samples). Efforts to obtain data on relative costs of testing in Europe and Tanzania proved unsuccessful up to the time of writing.

(iii) All surveyed laboratories are struggling to acquire SANAS accreditation. Others have only recently acquired it, as earlier discussed. However, since accreditation is given on a test by test basis, the recent achievements have not so far created significant benefits for the spices sub-sector. For instance, while the NFQCL laboratory is the only facility in the country that has acquired accreditation for *Salmonella* testing due to the importance of the hazard for the Nile Perch industry, the laboratory is not only far removed from spices production and marketing sites, but is also - at least for the time being - specifically reserved for the Nile Perch sub-sector. Moreover, there is no laboratory in the country which is accredited to test for Aflatoxins, pesticide residues, heavy metals, or artificial chemical dyes.

[11] Major breakdowns are frequent due to erratic power and water supply. Exorbitant repair and maintenance costs for laboratory equipments are also significant challenges. According to Mneney (*pers. comm.* 2007), manufacturers / suppliers do not disclose all technical details in regard to laboratory equipment supplied. This necessitates that laboratories obtain technicians from source to fix and repair. The exercise has so far proved very expensive and unsustainable. Donor funded equipment are more prone to this problem as each financier normally has its own preferred suppliers, a situation which leads to a large number of diverse suppliers / manufacturers per laboratory.

(iv) In the case of organic certification, TANCERT efforts to be accredited and be recognized as an international organic certification agency are far from being achieved. It is one thing to be IOAS accredited and quite another to gain international recognition.

According to Tanzania's National Trade Policy (2003), the general approach in export promotion is to align local standards with those of the major importers. Local capacity for conformity assessment is important for Tanzania, both in relation to the potential reduction in turn-round time and the possibility for more detailed informal technical interaction between actors. One major challenge is better coordination between, and greater efficiency of, Tanzanian institutions. The second challenge is completing the necessary investments and gaining international accreditation.

Theoretically, meeting local standards will prepare operators for participation in international markets. However, the documented local standards are not enforced, either in the domestic market or in regional markets within Africa and in low value markets in Asia. It is only if an exporter wishes to export to the EU that he/she has to meet either local or international standards. Because exports to high value markets like the EU are still quite low (see Akyoo and Lazaro, 2007), both enhanced conformity and improved conformity assessment for spices are distant prospects (except in the case of organic certification). The small number of exporters, the current modus operandi in production and marketing, and the demanding nature of conformity assessment techniques and accreditation requirements are not positive ingredients for investment in domestic conformity assessment, whether it is dedicated to spices or indeed if it is for agro-food exports in general. However, if all potential export industries that require such safety assessment are factored in, such an endeavour could become feasible and economical.

Incomes in the developing Asian countries are increasing. These are the countries that form the major market for conventional spices from Tanzania. Since demand for food safety is a function of income levels, it is likely that these countries also will demand higher levels of food safety in the very near future. In this sense, safety-related investments in Tanzania have a long term justification.

Organic certification is currently the most demanding type of food safety-related conformity that the Tanzanian spice industry engages with. Lack of international accreditation of the local certification body is making compliance costs exorbitant. Again since TANCERT will certify for all export crops and the organic market is growing worldwide, there is a case for public support for its achievement not only of international accreditation but also subsequent efforts to secure practical recognition.

Formulation of a National Food Safety Policy that defines the role of the private and public sectors as well as each individual institution will go a long way towards harnessing the currently scattered efforts for building a stronger national conformity assessment capacity in Tanzania. Unified public ownership of all public testing laboratories would as a first step enhance a common approach to building capacity. A second stage of such changes could be encouragement of private participation in testing laboratories.

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Annex 1: Tanzania standard physical and chemical requirements for black / white pepper, chillies and capsicum

S. No.	**Characteristics**	**Requirements for black / white pepper**	**Requirements for chillies and capsicums**
1	Colour and shape of mature crop	Grey or black + wrinkled surface	Orange red – yellowish green, oblong, conical pods
2	Odour and flavour	Fresh and pungent, free from foreign odour or flavour including rancidity and mustiness	Characteristic odour causing sneezing but not disagreeable and free from mustiness. For chillies -acrid flavour, very strong, very pungent, and very persistent. For capsicum – acrid flavour, moderately strong, moderately pungent, and moderately persistent.
3	Freedom from fungi, insects etc	Free from insect infestation, fungi, dead insects, insect fragments, and rodent contamination visible to the naked eye.	Free from insect infestation, fungi, dead insects, insect fragments, and rodent contamination visible to the naked eye (for both whole and ground).
4	Extraneous matter	Not more than 15% m/m for b/pepper and not more than 0.8% m/m for white pepper. Not more than 1.0% m/m of foreign matter not coming from the plant for whole b/pepper, or 0.5% m/m in whole w/pepper. Light berries less than 10% m/m, and pinheads ≤ 4% m/m. Total defects (pinheads + light berries ≤ 15% m/m.	Non-conforming berries to be less than less tan 5%.
5	Fineness	Ground pepper to pass through a sieve of 1.00 mm aperture size.	Ground chillies and capsicum to pass through a 0.5mm sieve.
6	Chemical requirements		
	(i) Moisture % (m/m) max.	12.0	10.0
	(ii) Total ash % (m/m) max.	8.0 (whole b/pepper) 4.0 (whole w/pepper)	8.0
	(iii) Acid insoluble ash in HCL % (m/m) max.	1.4 (ground b/pepper) 0.2 (ground w/pepper)	1.25
	(iv) Crude fibre % (m/m) max.	17.5 (ground b/pepper) 6.0 (ground w/pepper)	30.0
	(v) Non-volatile ether extract % min.	6.8	12.0

Source: TBS (1979a; 1979b)

Annex 2: EU Food Safety Standards on Spices

Hazard type	Spice type	EU std/limit	Required conform-ity assessment investment	Indicative cost* per unit (USD)
Microbial Pathogens (*Salmonella* bacteria)	Black pepper, paprika, etc.	(i) zero tolerance to Salmonella contamination (ii) Non-use of ETO (ethyl oxide) sterilization (iii) Non-use of irradiation procedures	(i) Autoclave (ii) Incubator (iii) Biological safety cabinet (iv) Water bath (v) Oven (vi) Stomacher -- --	10,000 6,000 15,000 2,000 4,500 3,000 -- --
Aflatoxins**	Chillies, Paprika, Ginger, Nutmeg, etc	(i) 10 ppb (parts per billion) for aflatoxin (B1+B2+G1+G2) (ii) 5ppb for aflatoxin B1. (iii) See annex 3 for individual country limits	High performance liquid chromatograph equipment (HPLC)	Modern HPLC model costs USD 100,000
Pesticide residues • Cartap • Inorganic bromide • Hydrogen phosphide	Ginger All spices All spices	No MRLs set for spices at EU level (only individual country MRLs especially Germany and Spain) - See annex 4.	Gas chromatograph equipment (GC) or Gas chromatograph mass spectrophotometer equipment (GCMS)	GSMS equipment model costs USD 76,126
Heavy metals - Mercury - Cadmium - Arsenic - Copper - Lead - Zinc	 -- -- All All All All	 Unspecified Unspecified 5 mg/kg 20 mg/kg 10 mg/kg 50 mg/kg	Atomic absorption spectrophotometer (AAS) equipment	AAS set costs USD 120,000
Prohibited food additives Para red Sudan 1	• Turmeric, Chilli, Paprika, Cayenne Pepper • Ground chillies, Chili, and Curry powder	Zero tolerance to both additives	HPLC equipment (as for aflatoxins). The difference will only be on the certified reference materials needed for the detection.	As above

* Figures for equipment costs were obtained from TBS and TFDA purchase records for 2007.
** Tracking of Ochratoxin levels in spices has also started in EU
Source: Jaffee (2004) and Kithu (2001).

Annex 3: Summary of legislation on aflatoxins in EU Member States

Country	Permitted Levels	For which products	Comments
Austria	B1<1ppb	All Food stuffs (except mechanically prepared cereals in the case of B1)	
Belgium	<5 ppb for Peanuts EU legislation is expected		In Belgian law Aflatoxins (and toxins in general) may not present in foodstuffs ie not detectable.
Germany	B1+B2+G1+G2<4ppb	All foodstuffs	
Denmark	B1<2ppb		
Netherlands	B1<5ppb	All foodstuffs	No controls on B2
Switzerland	B1<1ppb	All foodstuffs (except maize)	
	B2+G1+G2<5ppb	All foodstuffs	
United Kingdom	<50ppb advisory level for chilly		Only Aflatoxin Regulations on Nuts/Nut products Dried Figs/Dried Fig products, which when sold to the consumer must contain <4ppb total Alfatoxin. No regulations on Spices/herbs.
Spain	B1<5ppb B1+B2+G1+G2<10ppb	All Foodstuffs	
Sweden	B1+B2+G1+G2<5ppb	All Foodstuffs	
Finland	B1+B2+G1+G2<5ppb	All Foodstuffs	
Italy + France	< 10 pbb for B1		No Regulations
U.S.A	<20 ppb	All Foodstuffs	Guideline FDA

Source: EU Draft Legislation as quoted from Kithu, C. J. (2001)

Annex 4: Maximum pesticides residues limits in Germany, Netherlands & United Kindgom

Active Substance	Limiting Values in ppm		
	Gemany	Netherlands	United Kingdom
HCH without Lindane	0.20	0.02	0.02
Lindane	0.01	0.02	----
Hexachlorobenzene	0.10	----	0.01
Aldrin & Dieldrin	0.10	0.03	0.01
Sum of DDT	1.00	0.15	0.05
Malathion	0.05	0.05	8.00
Dicofol	0.05	0.05	0.50
Chlorpyrifos	0.05	0.01	----
Ethion	0.05	0.01	----
Chlordan	0.05	0.01	0.02
Parathion	----	0.10	1.00
Parathion methyl	0.10	0.10	0.20
Mevinphos	0.05	0.05	----
Sum of Endosulfan	0.10	0.02	0.10
Phosalon	0.05	1.00	0.10
Vinclozolin	0.05	----	0.10
Dimethoat	0.05	0.01	0.05
Quintozen	0.01	----	1.00
Metacriphos	0.01	----	----
Heptachlor & -epoxid	0.10	0.21	0.01
Methidathion	0.02	----	----
Diazinon	0.05	0.05	0.05
Fenithrothion	0.05	0.05	0.05
Bromophos	0.10	----	----
Mecarbam	0.01	----	----
Methoxychlor	0.01	0.05	----
Omethoat	0.40	----	0.20
Dichlorvos	0.10	0.05	----
Phosmet	----	0.01	----
Methylbromide	----	----	0.10
Tetradifon	0.05	----	----

Source: Kithu (2001)