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Health Hazards with Adulterated Spices: Save the "Onion Tears"

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ABSTRACT

Spices are among the top five most commonly adulterated food types because they are expensive commodities that are processed prior to sale, used most frequently and consumed by mass population. There is a strong incentive to pollute. In Bangladesh, different types of grounded spices powders are available like onion, ginger, coriander, chilli, turmeric, cumin, etc. These powdered spices are commercially processed and packaged by some leading food industries, while some local non-branded industries also exist. Nowadays, people are busy with their carriers, the demand of branded spices powder is increasing gradually. Generally, most of the people tend to buy loose spices from the local grocery store if branded and packaged spices are not available. This increases the risk of consuming adulterated spices. Unlike this particular adulterant which is not unhealthy (but illegal), most of the adulterants are unhealthy and can cause serious and fatal damage to our system if consumed regularly. The escalating market of this product implies that in Bangladesh this tradition is increasingly attaining momentum. Spices are consumed in various forms such as whole spices, ground spices, oleoresins, extracts etc. Spices play an important role in enhancing the flavor and taste of processed foods. They are also used in medicine because of their carminative stimulating and digestive properties. Ground spices maybe adulterated with artificial colors, starch, chalk powder, etc. to increase their weight and enhance appearance. High value ground spices are frequently adulterated for economic gains. Adulteration is difficult to identify by visual and sensory inputs alone. Although there are few renowned food industries, peoples are always suspicious about these products. But there are still not enough investigations for the quality check of all these branded powdered products.

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Background

Prices of onion started soaring after India banned its export on September 29, 2019. The following day, onion cost doubled in Bangladesh [1]. The price hike heated up the onion market in Bangladesh as the country meets a portion of its annual demand through import because of inadequate domestic production. Within the span of two months the price raised more than 500% which is the highest in the history of Bangladesh [2]. Bangladesh produces 1.7 million to 1.9 million tons of onion annually and imports 700,000 tons to 1.1 million tons to meet the domestic demand [3-6]. The government has now decided to start flying in onions from Turkey and Egypt and continue the process until new produces from the Bangladesh farmers and shipment of consignments through the sea arrive [7,8]. The Financial Times reported that the Indian government itself pledged to import onion after prices increased 500% from the start of the year [9]. If “onion prices falling tears”, we have to save tears for other adulterated spices. The problem is not only ignoring the human rights for safer food but also endangering public health seriously with numerous acute and chronic diseases.

Introduction

Among a database of more than 1000 records of food adulteration worldwide between 1980 and 2010, more than 10% of scholarly articles and nearly 90% of media reports related to spices, many featuring toxic synthetic chemical dyes of similar chemical structure [10]. Looking at the past 10 years of data for herbs/spices, chili powder, turmeric, and saffron have the highest number of fraud records and chili powder, turmeric, and paprika (spices to be powdered for cooking) have the highest number of distinct adulterants associated with them [11]. Adulterated spices are not very different in appearance as compared to a batch of unadulterated spices. This makes it difficult for consumers to make an informed decision when purchasing the spices. Large food manufacturers use sophisticated technology that can compare the smells and tastes of various samples to detect possible adulteration. When buying spices loose, however, the possibility of adulteration is much higher. According to WHO, food contamination and adulteration situation of Bangladesh is a serious public health concern. Unsafe/contaminated food causes many acute and life-long diseases, ranging from diarrheal diseases to various forms of cancer [12].

Exhibit 1. Food Safety Laws and Regulations and Food Standards in Bangladesh
Agricultural Products Market Act, 1950 (revised in 1985)
Fish Protection & Conservation Act, 1950 (latest amendment in 1995)
The Food Grain Supply (Prevention of Prejudicial Activity) Ordinance, 1956
The Bangladesh Pure Food Ordinance, 1959 (Bangladesh Ordinance No. LXVIII of 1959)
Agricultural Pest Ordinance 1962
Agricultural Produce Markets Regulation Act, 1964 (revised in 1985)
The Cantonments Pure Food Act 1966
Destructive Insects and Pests Rules, 1966 (Plant Quarantine) amended up to 1989
The Bangladesh Pure Food Rules 1967
The Special Powers Act, 1974
The Animals Slaughter (Restriction) and Meat Control (Amendment) Ordinance, 1983
Marine Fisheries Ordinance, 1983 and Marine Fisheries Rules, 1983
Fish and Fish Products (Inspection and Quality Control) Ordinance, 1983
The Pesticide Ordinance, 1971 and The Pesticide Rules, 1985
Bangladesh Standards and Testing Institution Ordinance, 1985 (XXXVII of 1985)
The Radiation Protection Act, 1987
The Iodine Deficiency Disorder Prevention Act, 1989
The Essential Commodity Act, 1990
National Food Policy 1996
National Agriculture Policy 1996
Fish and Fish Products (Inspection and Quality Control) Rules, 1997
National Food and Nutrition Policy 1997
National Fisheries Policy 1998
National Policy for Safe Water and Sanitation 1998
National Health Policy 2000
Bangladesh Standards and Testing Institution (Amendment) Act, 2003
The Bangladesh Pure Food (Amendment) Act, 2005
Product Labeling Policy 2006
National Livestock Policy 2007
Fish Feed and Animal Feed Act 2010
Export and Import Policy 2009-2012
The Bangladesh Food Safety Act 2013
BSTI Ordinance and many others

Exhibit 2. Laboratories for Food Analysis
Public Health Laboratory (IPH)
BSTI (Ministry of Industries)
Food testing Laboratory (Ministry of Food & Disaster management)
Food testing Laboratory (Dhaka City Corporation)
Institute of Food Radiation Biology, Bangladesh Atomic Energy Commission
Institute of Food Science Technology, BCSIR
Institute of Nutrition & Food Science, University of Dhaka

Exhibit 3. WHO published – chemical exposure to toxic level
Carcinoma Cardiovascular disease Kidney, liver dysfunction Hormonal Imbalance Premature birth Suppression of Immune system Impaired development of nervous system Mental health problems and Learning disabilities/Cognitive dysfunction

Adulteration of Spices: Public Perception

A recent study on consumer perception towards quality of spices powder available in Bangladesh shows that more than 90% people believed that the spices powders are not of good quality. People also think that these adulterated spices powder may also responsible for different types of diseases including cancer, chronic nephritis, high blood pressure, headache, intestinal problem, allergy, etc [13]. The addition of wheat flour to powdered ginger with enough capsicum to restore the pungency and enough curcuma to maintain the natural color is a typical example of intentional adulteration [14]. Cinnamon is at very high risk of fraudulent adulteration, substitution and dilution due to high price. Cassia, a low-grade cinnamon like bark which is toxic also, imported from China is cunningly added and mixed to cinnamon bulk. Cassia barks are tougher and thicker. They rarely give out any aromatic smell [15]. Argemone seeds are the common adulterant for mustard seeds. Green cardamom pods are often adulterated with “used” cardamom pods, or ones from which volatile oils have already been extracted [16]. Sawdust is the common adulterant used in cumin. Candied corn silk and colored plastic often make their way into dainty boxes of saffron [17]. This is also known as sophistication, which means no stone is left untouched to produce a food item which would probably look even better than a naturally grown/produced food and food products.

Ongoing Adulteration Practices

The motivation for deliberate adulteration has usually been economic gain and involves common practices such as substituting plant material from a totally different plant, e.g., substituting black pepper fruits (*Piper nigrum*) with papaya seeds (*Carica papaya*) based on the similarity of the external appearance of black pepper and papaya. Another scenario consists of the addition of an inferior species containing less of the desirable active principal(s), or possessing less potent flavoring properties, but is commercially cheaper. Some additional common, on-going adulteration practices for spices and herbs are as follows:

(a) Substitution (partial or complete) with solvent-exhausted material (e.g., exploiting exhausted ginger).

(b) Substituting the genuine plant part by other parts of the same plant which might be devoid of or possess less of the bioactive ingredients (e.g., the inclusion of clove stalks that contain less essential oil than the flower buds, stems in sage and laurel leaves, and black pepper in white pepper).

(c) Adulteration with common universal adulterants (bulking agents or fillers) such as ground grass, sawdust, straw, different kinds of cereals, starches, or bran (e.g., garlic powder and onion powder with corn starch, colored sawdust in turmeric, and red brick powder and bran in chili peppers)

(d) Inclusion of pure chemicals to spices that are prediluted with fillers such as starch and straw to artificially impart strong flavors and perception (e.g., piperine to

black pepper, capsaicin to ginger, and curcumin to chili pepper).

(e) Addition of unrelated specific vegetable fillers to mimic morphological and micromorphological properties (e.g., olive leaves to oregano and sage).

(f) Inclusion of inorganic substances such as chalk, lime, powder of red brick, and metal salts (e.g., chili pepper powder with red brick and lead salts and turmeric with red lead chromate).

(g) Addition of nonpermitted dyes (e.g., oil-soluble carcinogenic Sudan I–IV, metanil yellow, and dimethyl yellow and water-soluble dyes such as rhodamine B, a pink basic dye) [18].

US Import Alert from Bangladesh and India

According to American Spice Trade Association (ASTA) and Indian Institute of Spice Research (IISR), different adulterants are used in spices to make them cheaper than original one likely color, starch of maize, wheat, tapioca and rice in turmeric, chilly and curry powder; brick powder grit, sand, dirt and filth in chili powder; dung powder and common salt in coriander powder. Beside these different foreign seed powder, color, floral waste, leaves, husks, Sudan red may also have uses to make spices powder adulterated. So, consumer perception may be true in case of addition of suspected adulterants [19]. Journal of Sustainable Development Research, 2019 revealed intentional addition of brick dusts and artificial colors (in mixed spices, turmeric, cumin and chili powders); dust from outer layer of rice (in mixed spices and coriander powder) and papaya seeds in pepper. Brick dust and saw dust causes respiratory problems. Coal tar and industrial Dyes in powdered spices are carcinogenic (causes cancer upon long-term exposure), specially Metanil Yellow Aniline dyes in turmeric powder [20]. In September 2013, the US FDA announced voluntary recall by distributors of “PRAN” brand turmeric powder, a Bangladeshi company, due to elevated levels of lead [21]. Additional studies identified the presence of contaminated spices originating from India and Bangladesh in markets in Boston, MA [22-24]. The FDA has released detailed import alerts for lead-adulterated turmeric, naming importing companies and the country of origin. All are from Bangladesh and India [25].

The “Turmeric Turmoil”

A relative of the ginger root, turmeric is grown predominantly in India, as well as Bangladesh, Myanmar, China, and Nigeria. Uptake of lead from soil into the turmeric is a possible, but unlikely, source of contamination, as previous researchers estimate the maximum uptake of lead into the root of the plant to be approximately 10% [26]. Very recently, researchers of Stanford University, California and ICDDR, B exposed the nefarious act of yellow pigment (lead chromate) adulteration to enhance brightness in 7 out of the 9 major turmeric-producing districts [27]. Turmeric lead and chromium concentrations were highest in Dhaka and Munshiganj districts. Analyzing soil samples and gathering interviews with farmers and spice makers, researchers have found lead levels in turmeric that exceed national limits by up to 500-fold [28-30]. "Unlike other metals, there is no safe consumption limit for lead, it's a neurotoxin in its totality," said the papers' senior author Stephen Luby, professor of medicine and the director of research for Stanford's Center for Innovation in Global Health. "We cannot console ourselves proposing that if the contamination were down to such and such level, it would have been safe" [31].

Health Hazards of Consuming Contaminated Spices

Adulteration is attributed primarily to increased demand or supply shortage of the spices and aromatic herbs. As spice trading has exponentially increased globally, herbs and spices have become prone to adulteration, which can be deliberate or unintentional. Deliberate adulteration is usually economically motivated, aimed at maximizing profit margins, whereas unintentional adulteration is often attributed to improper harvesting or processing of the plant material or collecting/substituting closely related species [32,33]. Spices and

herbs, being high-priced commodities, have been often subjected to adulteration in many ways which reduces their quality and potentially has harmful health implications. The motivation for spice fraud is largely attributed to economical interest to gain greater profit margins and such adulteration of spices can have serious implications for public health.

Table 1. Toxic Elements in Noxious Addition of Spices with Possible Outcomes [20], [32-43]

Contaminants	Spice Type	Possible Outcome
Coloring agents chrome, tartzine and erythrosine	Mixed Spices	Cancer in kidney, liver, skin, prostate and lungs
Coal tar and industrial Dyes	Powdered spices	Carcinogenic
Brick Dust	Chili powder	Respiratory problem
Metanil Yellow Aniline dyes	Turmeric powder	Carcinogenic
Yellow and Sudan Red colors (ibid)	Chili powder	Tumors in liver and bladder and finally for cancer
Lead (II) chromate (PbCrO4)	Turmeric powder	Lead poisoning may cause neurotoxicity, nephrotoxicity, anemia, reduced male fertility. Chromium (VI) is involved in the process of carcinogenesis.
Sudan Red (typically used to color oils and waxes, including shoe polish)	Paprika, chili powders	Class III carcinogens, considered harmful to human health due to their teratogenicity, genotoxicity, and carcinogenicity.
Cinnamon	Cassia	Cassia cinnamon, but not Ceylon, is a very rich source of coumarin.
Mustard seeds.	Argemone seeds	Argemone oil poisoning include vomiting, diarrhea, nausea, swelling of limbs, erythema, pitting edema, breathlessness
Green cardamom pods	Used pods	Newer pods will be plum and full, but used ones will be wrinkled and feel empty, devoid of any health benefits.
Black Pepper	Papaya Seeds, piperine, expired green and red chili	Papain content may cause natural uterine contraction and may lead to abortions.

Conclusion and Recommendation

Worse still, in many cases the used and exhausted spices are mixed with fresh ones in small quantities to confuse the consumer. The most obvious and simplest reason is to increase profit. A manufacturer may use a cheap filler that is easily disguised in the spice to increase the volume sold thereby cutting the cost of pure spice, and thereby y increasing the ultimate profit margin. The relevant policymakers do need to look into the issue seriously, if they are really interested to prevent health hazards from contamination and adulteration. A robust surveillance is necessary for assessing marketed food items in Bangladesh, prompt notification of public health emergency and a year-round campaign against notorious daredevils.

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