
Spices
Playbook 1.0
taste'n balance
—for healthier generations—
Nestlé
Research
Nestlé Development Centre
Manesar

Foreword

At Nestlé, we are committed to the taste and goodness of food. Our strategy is built on ‘Taste & Balance’ and our commitment to the four values of ‘Simply Good’. We are in the midst of a new food reality marked by changing eating behaviours and beliefs. Millennials and Generation Z are driving these changes, calling for more ingredient transparency and demanding more, asking: What is in my food? How was it made? Where does it come from? These digital natives have spurred a demand for innovative and ethnic cuisines and they seek transparency from brands that they trust and believe in. Responsible ingredient sourcing is our key endeavour in addressing these needs from the thoughtful choice to the careful preparation of important culinary ingredients, like spices, to craft authentic products that win consumer’s preference, rooted in a brand purpose deli supported by meaningful commitments.

As younger (and all) generations learn new ways to cook, we can help inspire them to discover new tastes and experiences. Spices play an integral role in cooking and shape cuisines around the world. Their use heightens the culinary appeal of many dishes. Apart from adding colour, flavour and taste, consumption of spices is also associated with providing health benefits. We believe this makes spices important to strengthen our ‘Taste & Balance’ journey. The use of Science and Technology to differentiate and enhance the natural properties of spices will help to reinforce our leadership in culinary and provide uniqueness to our offer. To inspire consumers, we need to firstly build our passion and knowledge amongst our culinary community, and the Spices Playbook is the first step in delivering into our ambitions. We believe this Playbook will begin a journey to bring breadth and depth to our commitment to select the right ingredient, ensure it is responsibly sourced and prepare it with care for use in the many culinary products our consumers enjoy, every day.

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Spices
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Message

Oliver Chmiel
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Spices Playbook is an inspirational booklet to bring the world of spices along with culinary art closer to Nestlé. Spices are perfect ingredients to explore new combinations of tastes and experiences in line with Nestlé 'Simply Good' philosophy. Spices are valued for their intrinsic goodness in taste, nutrition and culinary appeal; an ideal partner for the Nutrition, Health and Wellness journey. They are also strategic ingredients with perceived value addition to consumers worldover. Spices have been an ingredient of choice for centuries for its flavouring and colouring properties along with the well perceived health effects. When it comes to usage of spices, there is always more to learn: what happens when they are added whole or ground, dry roasted or oil roasted, how same spices of different blend ratios brings characteristic underlying flavour of world cuisine from the Thai to Caribbean, Chinese to European, Indian to Middle Eastern and so on.

This Playbook is the culmination of knowledge within Nestlé from literature reviews and other publications, carefully brought together in the form of chapters. In this Playbook attempt has been made to cover most aspects of spices including the history, value chain, science of spice, sensory and consumer insights, chef's insights, transformation technology, food safety, health benefits and regulatory. With the consumer research on spices, it was evident that taste, health and aroma are the most expected attributes from spice. Spices are gaining on superfood status in consumer perception similar to fruits and vegetables. Increased globalisation is driving the usage of spices along with heightened awareness on natural and clean ingredients. As per USDA, per capita consumption of spices (calculated as, per capita availability) has tripled to 3.7 pounds, over a period from 1966 to 2015.

Spice Playbook is an endeavour to inspire users within Nestlé to use more spices in recipes to support Kitchen Cupboard initiative and tap the real potential of spices. It gives us an opportunity to build consumer relevant stories riding on nutrition, health and wellness, taste and aroma medicinal credentials or communication of provenance stories giving our consumers a positive story to reckon with.

Chapters

CHAPTER 01 World of Spices

Over centuries, spices are the soul of global cuisine and virtually indispensable in the culinary art.

The fundamental function of spices is to provide aroma, colour, flavour, taste or texture to food. The function of spices include its usage as a preservative, antioxidant and medicine. The spices have a significant role in cooking as it makes the dish richer with the distinctive depth of flavour and colour. Having the right choice of spices in the right form and combination in our products will help Nestlé to tap the potential of spices of its maximum flavour delivery and indulgence. While the usage of spices has been well documented over 6000 years, the native spices are found to be playing an important role in differentiating one country's cuisine with other.

Spices vs Herbs vs Vegetables

The definitions for spices, herbs and vegetables from numerous sources ranging from botanists, herbalists and horticulturists, tend to overlap. A broad consensus puts the leafy portion of a plant used for its flavouring properties as herbs (e.g. Coriander leaves, Parsley, Oregano), while if it is any other part of plant like root, fruit, bud etc., it is called as spice (Turmeric, Chilli, Clove). Vegetables are plant parts that are edible (e.g. carrot, potato, broccoli). We can find exceptions for these general definition in spices, herbs and vegetables. Bay leaf which is a leaf is considered a spice and is used in its dried whole form in Middle Eastern and Asian cuisines. Onion and Garlic are considered as either spice or vegetable. Nestlé classification, though, include Onion and Garlic as well as other allium genus plants and their dehydrated forms in Vegetables. Wasabi which is a stem is considered as spice due to its pungent and spicy nature.

What is a Spice?

The term 'Spice' means any aromatic vegetable substance in the whole, broken, or ground form, except for those substances which have been traditionally regarded as foods, such as Onion, Garlic and Celery; whose significant function in food is seasoning rather than nutritional; that is true to name; and from which no portion of any volatile oil or other flavouring principle has been removed.

(USFDA 21 CFR Sec. 101.22(2).

Spice Classification

Spices add different flavours at various intensities, depending on the usage and type of dish and food matrix. Spiciness, hotness, sweetness, pungency, nuttiness are some of the multitude of flavours, spices can deliver. Conventionally spices can be classified into Hot Spices, Mild Spices and Aromatic Spices based on its sensorial properties and flavour intensity. Spices can also be classified on the basis of the different plant parts they are derived from, viz. Tree spices (e.g. Cinnamon, Cassia, Nutmeg), Seed spices (eg. Coriander, Cumin, Fenugreek) Root Spices (e.g. Ginger, Turmeric).

Conventional Classification of Spices

Category	Spices
Hot Spices	Capsicum (Chillies), Cayenne Pepper, Black and White Peppers, Ginger, Mustard
Mild Spices	Paprika, Coriander
Aromatic Spices	All Spice (Pimento), Cardamom, Cassia, Cinnamon, Clove, Cumin, Dill, Fennel, Fenugreek, Mace and Nutmeg

Source: ISO and the Handbook of Herbs and Spices Second Edition, Volume 1

Classification Based on Plant Parts used

Plant Component	Example
Bark	Cinnamon, Cassia
Fruit	Cardamom, Chilli, Paprika
Bud (Unopened Flower Buds)	Clove
Pistel (Floral Parts)	Saffron
Seed	Mustard, Fenugreek, Fennel, Celery, Aniseed, Coriander
Rhizome (Underground Stem)	Turmeric, Ginger
Aril (Bracket Covering Seed)	Mace
Leaf	Curry Leaf, Bay Leaf
Bulb	Onion, Garlic
Kernel	Nutmeg
Latex from Rhizome	Asafoetida
Root	Angelica, Horseradish

Spice Journey

Spices have played a significant role in civilization and history of nations. Spice trade gained popularity throughout Asia and the Middle East in around 2000 BC. Its contribution to world civilization is well recognized, as it led to establishment and destruction of empires, discovery of new continents and in many ways helped to lay the foundation for modern world. Many maritime routes were developed between India and China which later developed into the spice route. The Spice Route is the name given to the network of sea routes that link East with the West. Spices from India, East Asia, and the East Indies were in demand and carried by caravan across China and India to ports of the Mediterranean Sea or the Persian Gulf and then to the marketplaces of Athens, Rome, and other cities, where they were sold at relatively high prices. The most traded items of commerce were seasonings such as Cinnamon, Cassia, Cardamom, Ginger, and Turmeric.

It was the lucrative and legendary spice trade that swayed the course of history as they commanded great value. Today, spices have lost the status and allure that once placed them alongside precious metals.

6000 BC-5000 BC
The 'Vedas' has reference on the use of spices (Black pepper and Turmeric) for medicinal purposes

3500 BC-1500 BC: Egypt
Culinary Spices are used for food preservation and to add flavour to the food. Health benefits of Spices like Coriander, Fennel, Ginger, Cumin, Garlic are classified

1000 BC
India established as major spice trade centre

200 BC-800
Romans control the trade

700-1500
Marco Polo's exploration of Asia established Venice as most important trade port and remained prosperous until 1498

1101-1600
Europeans explore passage to East Indies

1401-1700
Wars for control of Spice trade break out

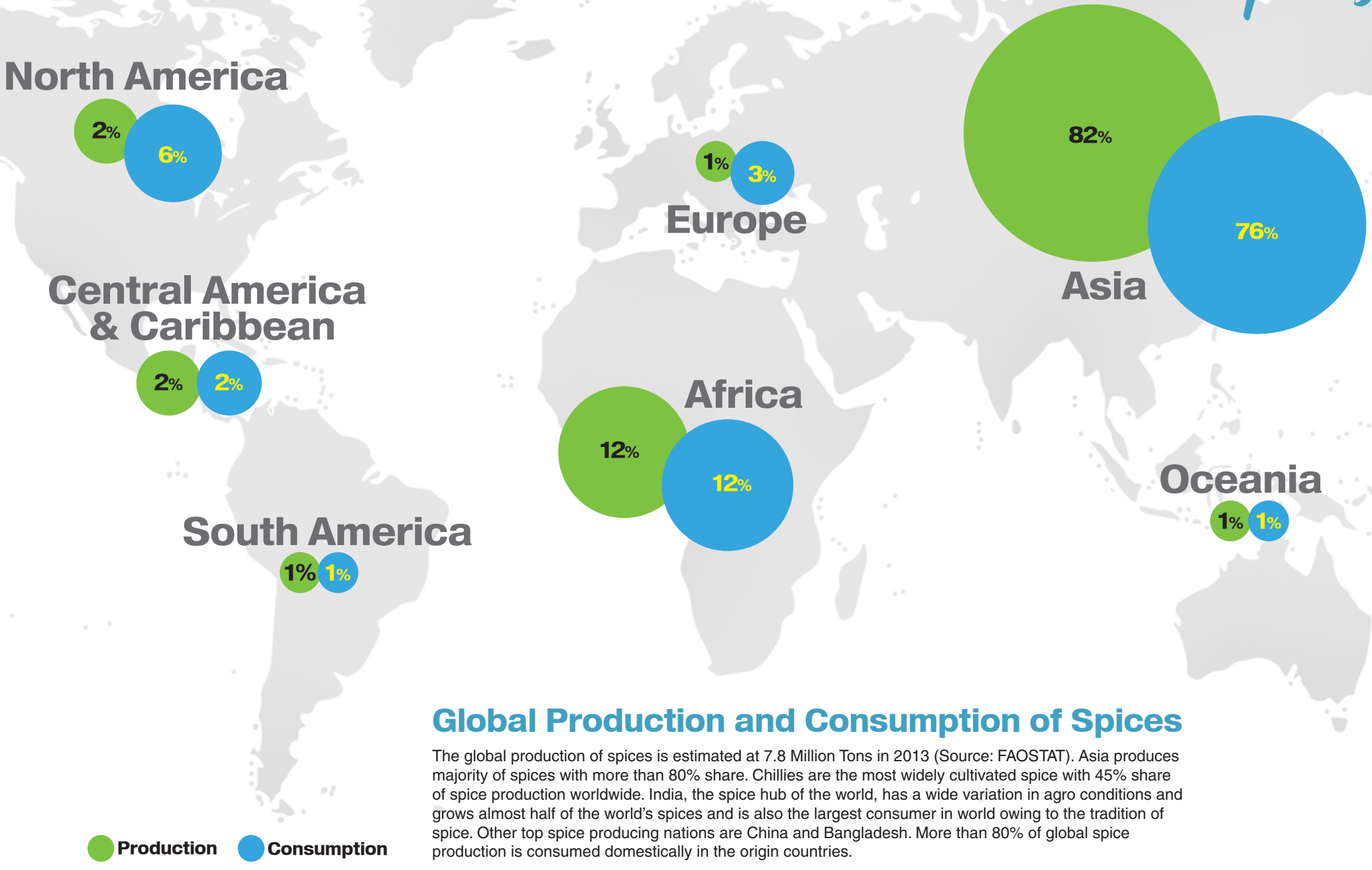
1492
Christopher Columbus arrived in America while searching for a direct western route to the Spice Islands

1498
Vasco da Gama discovered first sea route to India

1500-1800
English exploration

1600-1900
Americans enter the Spice trade

2013
Spice trade at 1,500,000 MT



Global Production and Consumption of Spices

The global production of spices is estimated at 7.8 Million Tons in 2013 (Source: FAOSTAT). Asia produces majority of spices with more than 80% share. Chillies are the most widely cultivated spice with 45% share of spice production worldwide. India, the spice hub of the world, has a wide variation in agro conditions and grows almost half of the world's spices and is also the largest consumer in world owing to the tradition of spice. Other top spice producing nations are China and Bangladesh. More than 80% of global spice production is consumed domestically in the origin countries.

The consumption of spices is increasing steadily throughout geographies. The largest drivers of consumption are the increasing popularity of spices and ethnic foods, food innovation and diversification, health awareness and growing demand for convenience products such as ready-made meals and processed foods. Turmeric, Chilli Pepper, Paprika and Ginger are some of the spices which are gaining popularity. Cinnamon (seasonings, bakery products, beverages), Cloves (meat, confectionery, wine), Mustard (sausage, grilled meat, eggs), All Spice (pickles, marinades), Bay Leaf (pickles, soups, meat) and Nutmeg (vegetable and meat dishes, confectionery, pastries) are also becoming popular.

Spices	Largest Producer	Second Largest Producer
Black Pepper	Vietnam	India
Cardamom	Guatemala	India
Cassia	Indonesia	China
Chilli Pepper	India	China
Cinnamon	Indonesia	China
Cloves	Indonesia	Madagascar
Coriander	India	Morroco
Cumin	India	Syria
Ginger	India	China
Nutmeg	Guatemala	Indonesia
Saffron	Iran	Spain
Vanilla	Madagascar	Indonesia

Global spice trade was estimated to be 1.5 Million Tons in 2013 of which almost 50% was imported by EU, USA and Japan. Vietnam is the world's largest producer and exporter of Black Peppercorns. Other major producers of Black Pepper include Indonesia (19%), India (11%) and Brazil (9%). India is the main producer and consumer of Cumin and produces 70% of the world supply and consumes 90% of this. Other producers of Cumin are Syria (7%), Iran (6%), and Turkey (6%). India is the largest producer, consumer and exporter of Turmeric in the world and accounts for about 75% of world Turmeric production and 60% of world export.

Source: FAOSTAT (2013)

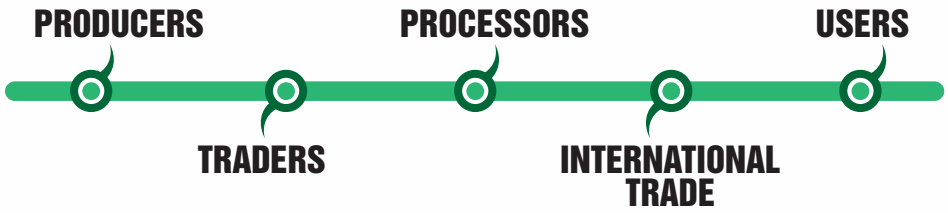
CHAPTER 02 Spice Value Chain

The world spice market is complex with diverse supply chains and products being sourced from a variety of businesses ranging from large scale producers to marginal farmers.

Many spices grow wild and are farmed on a village or subsistence scale in exotic parts of world mainly Asia. Often many intermediaries are present in the supply chain from farmer, collector to middle-man before arrival at the origin processor/shipper. Spices are contained in almost every processed food and are used by consumers for a range of applications throughout the globe as discussed in Chapter Chef's Insight. Securing this value chain from primary production to consumer ready food against the natural, accidental or intentional biological and chemical contaminations is therefore directly related to the safety of food products. This chapter is focused on the current status of supply and processing chain in the spices value chain.

Complexity of Spice Value Chain

The spice value chain essentially comprises of upto ten tiers between the producers and consumers.

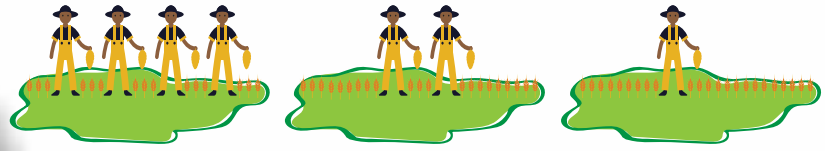


Majority of spices are produced in Asian countries like India, China, Bangladesh and parts of South East Asia. Once harvested, the dried spices are shipped from farms all over the region to the regional market yard, where they are collected and auctioned in lots. The spices are then typically passed on to a processor, where they are milled into powder ready for export. After this, the next phase involves the shipper who takes them to an importer or distributor abroad, and possibly on to a food retailer or food manufacturer and finally to the consumer. All of these nodes from farmer to consumer have their own characteristics that are addressed in this chapter.

Producers

The production of spices is concentrated in Asia which accounts for more than 80% of world production. Majority of the spice cultivation is done by the marginal and small farmers with very less mechanisation and hence depending on manual labour. It is estimated that around 5 million smallholder farmers are involved in spice production. The spices that are available in the domestic and international markets are produced by the small farmers with less than 2 ha of landholding. This translates to low yield, cultivation practices based on traditional knowledge which has been transferred from generation to generation. This heterogeneity at the primary production implies a huge gap between the international standards and the practices on the field. For these small and marginal farmers, the quality and grading norms of spices are benchmarked on the local trading market. Hence there is no direct incentive for these farmers to adopt the practices prescribed in international norms. The significant size of domestic market in the major producing countries such as India, China and Bangladesh also contributes to the fact that these good agricultural practices remain an abstract concept for majority of farming community. The primary production is characterized by a large number of small holders, who are in general price takers. Their negotiation power is limited by financial stress or the lack of storage capacity (The dried spice requires necessary storage conditions and, lack of such conditions lead to deterioration in quality, if exposed to humidity, light or contamination).

Profile of a Spice Farmer



Marginal Farmers: Less than 1 ha landholding around homesteads and in natural forests. The farmer sells the produce to local traders, as the volume is not substantial to be sold in regulated market.

Small Farmers: 1-2 ha landholding. The farmer rows crop with objective of sales and has the financial strength and volume to tap the regulated market directly or through commission agents.

Large Farmers: More than 2 ha.

Note: Figures based on Turmeric Farmers in India.

Traders

A large number of small traders cater to the domestic market. The smallholder farmers depend on local collectors, village or district traders for selling of their produce. A large share of spices are consumed locally and the remaining share (of export grade) is traded internationally through large traders according to the prevailing quality norms in the import client.

The trading channel can be classified into two categories as:

a. Domestic oriented: The channel dedicated to local use mainly making use of local collectors and traders.

b. Export oriented: The wholesale traders largely control this channel. They have strong network with local traders and have storage capacity. They also act as credit lenders for farmers.

Spice Value Chain

Producers

Spices are produced majorly by small and marginal farmers and a few large growers. Small growers only involve in post harvest activities whereas large growers additionally get involved in certain pre-processing activities

Traders

Small and marginal growers depend on local and district traders to market their products. Spices traded internationally generally transit through wholesale traders.

Processors

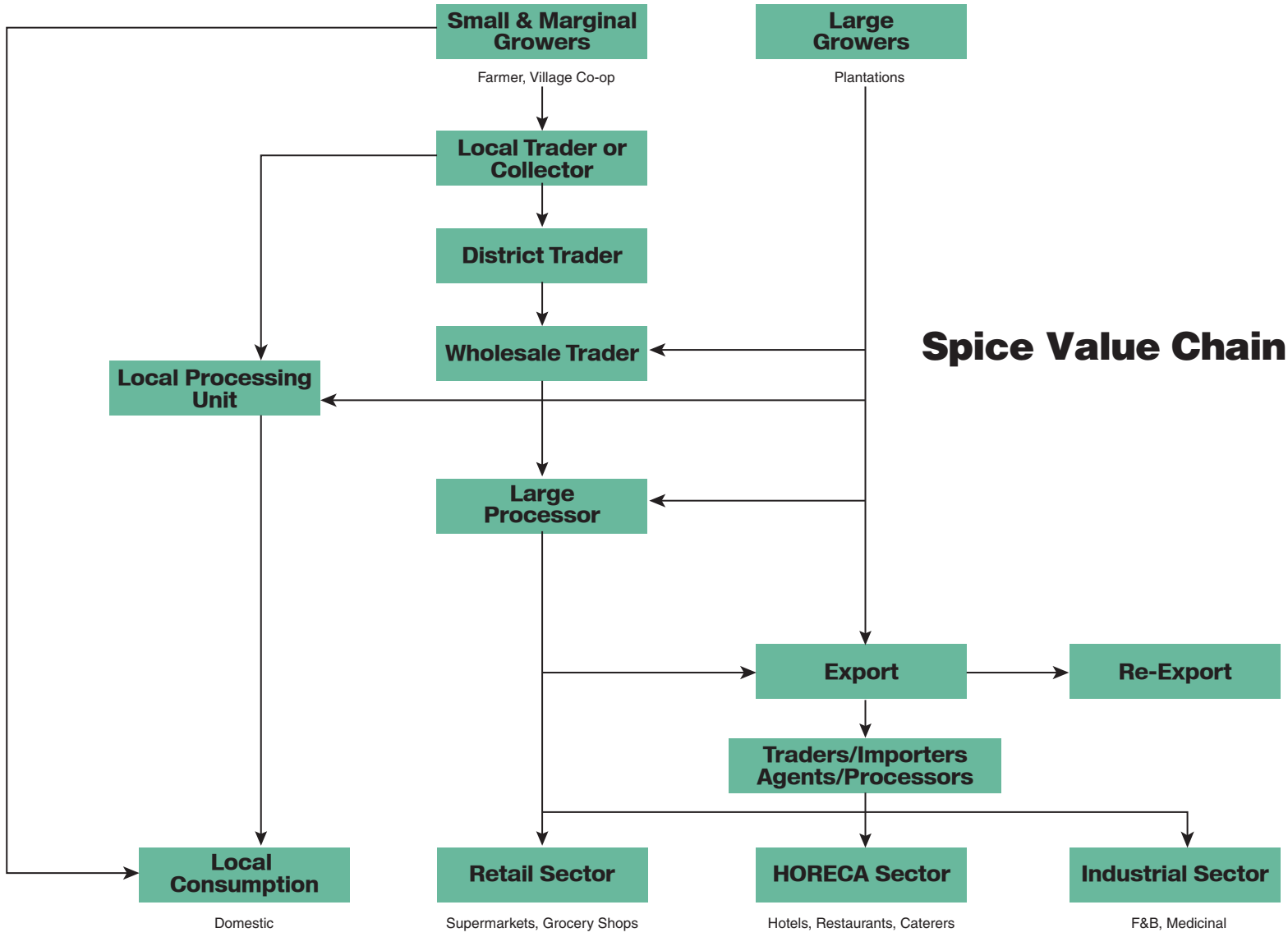
The processing of spices (grading, cleaning, drying, grinding, packaging) for local consumption is done by small processing units or by medium-large processors. For international clients, products are processed by large processors according to stricter quality and hygiene standards

International Trade

International trade is characterised by a network of traders, importers and processors. Spices produced in bulk in native producing nations are traded on the world market. Other products that are traded in smaller quantities or according to special specifications are sourced from agents or importers directly.

Users

The final application of spices, includes direct domestic consumption, sale through the retail sector for household consumption or usage by the catering sector along with industrial usage of spices in F&B and medicines.



Spice Value Chain

Processors

The processing of spices includes drying, cleaning, grading, grinding, sterilisation and packaging. In many cases the processing for local consumption is mainly done by small local processing units or by medium-large processors which cater to the organised market. In other cases spices are processed by the large processors as per the quality and hygiene standards of international clients. Some of these processors are well integrated into the international chains. Most of these processors are concentrated in the producing countries. However, there are processors in import countries too, especially in Europe and USA. The role of these processors includes sourcing, cleaning, sterilisation (treatment for bacteria and spores), grinding, warehousing, blending and selling.

International Trade

Different spices and origins and markets, all have their own demand and supply dynamics. Conventional spices produced in bulk are traded in the international market. The main spice trading centres are Rotterdam, London and Hamburg. The spices with a particular specification requirement such as grade and origin are sourced from agents or importers directly. There is an active inter trade among trade houses and international brokers.

Users

The food processing industries including flavouring companies are the largest users of spices at 55-60% of total industrial spice use. The retail sector (30-35%) comprises of different branded spices for home consumption. Consumer demand for healthier and better tasting products drives the spice usage as it meets the aspiration for natural products. The catering sector (10-15%) includes the restaurants, bakeries, confectioneries. (Source: CREM, 2010)

Value Chain Challenges and Risks

The spice value chain is highly fragmented and this often makes it important for responsible companies to know the value chain to understand the risks and mitigate them. Every part of the supply chain has a role to play in assuring product integrity, whether as growers, primary or secondary processors, agents and brokers, packers, food manufacturers, retailers, foodservice operators or wholesalers/cash and carry businesses. The more intermediaries the spices pass through, the more opportunity there is for tampering and the harder it is to identify the impact node. However, the challenges in spices is not limited to only food fraud but rather extends to the various aspects of quality, supply security, price pressure, transparency and authenticity. These factors together greatly influence the dynamics of the spice industry.

Quantity

Crop Failure, Low Yields

Competition from other cash crops (rubber) or activities (mining)

Quality

Sub Optimal Farming and Handling Processes

Adulteration and Contamination

Price

Price Volatility

Short Term Contracts

Transparency

Complex Value Chain

Intermediaries and Inter State Trade

Disputed Information

Short Term Contracts

Backward Integration and the Sustainability Model

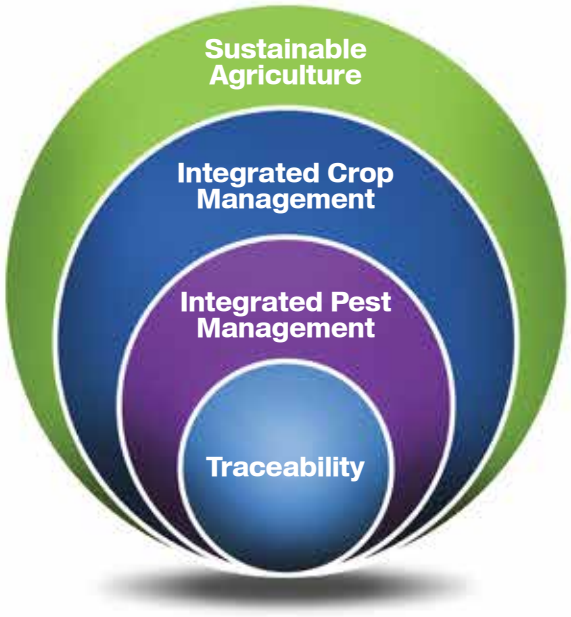
The spice value chain is long and complex. It can be very difficult to trace back more than one or two levels. Backward coordination in the form of contract farming agreements exists in an informal manner. Contract farming for cultivation of spices are restricted in major spice growing countries. In recent years, the trade and processing of spices has taken a generational shift towards more organised production and trade. Many international processors directly import their spices rather than using importers or brokers. They form partnerships or joint ventures to source and process the spice produce in the growing country which enables them to have more transparency in the value chain. This vertically coordinated supply chain helps in securing the supply of spices of a specific quality or origin.

Integrated Pest Management (IPM) is a program in which the spice suppliers partner with progressive and innovative farmers who are adaptive to quality requirements, guiding them on good agricultural practices, educating them on judicious usage of approved fertilizers and pesticides, providing technical assistance through selection of hybrid, high yielding along with pest resistant seed varieties and pre harvest and post harvest practices. These IPM programs typically also have buy back arrangements with farmers for the final produce.

Integrated Crop Management (ICM) is a holistic approach to sustainable agriculture. It considers the situation across the whole farm, including socio-economic and environmental factors, to deliver the most suitable and safe approach for long-term benefit. This means carefully considering site selection, soil management, seed and planting material, crop rotation, crop nutrition, pest management, water management and landscape management that fit the local conditions and climate.

A sustainable agriculture is the production of food, fibre, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare.

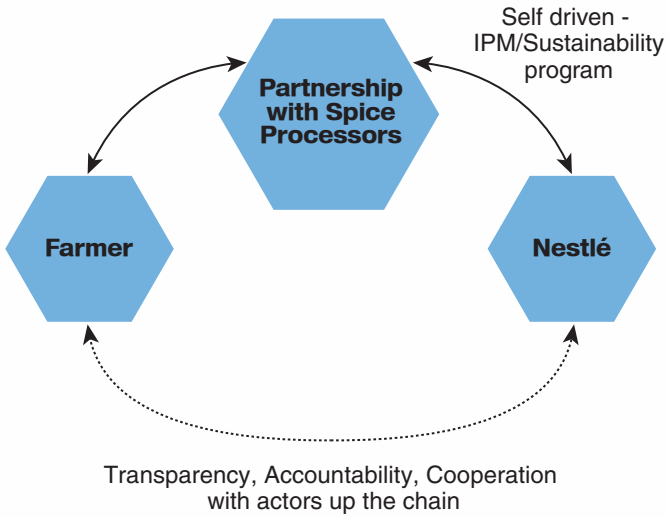
This type of agriculture produces healthy food without compromising future generations' ability to do the same. However, growing demand is a key driver for better farming practices which will improve the livelihoods of farmers, and improve the socio-economic and environmental conditions under which spices are produced. This is a constant journey for the producers, processors and consumers to achieve sustainability in spices production which will transform the spices sector. Typically sustainability evolves from a stage of risk minimization to a stage of internalization of CSR principles into the core operations, to an ultimate stage where there are a common set of voluntary principles across competing companies.



The MAGGI™ Plan

'The MAGGI™ Plan' is led by Nestlé India to achieve a sustainable model of spice value chain together with a few other key ingredients. The operationalisation of this plan enables Nestlé to secure the spices value chain from farmer to Nestlé factories, while ensuring ingredient quality, food safety and sustainability in the long run. The initial steps are well underway and the first stage with the 'Big 4 Spices': Red Chilli, Turmeric, Coriander and Cumin will be operationalised by 2017-2018 crop season with full traceability till the IPM farmers by bringing down the number of tiers involved.

Maggi Plan Model



The MAGGI™ Plan will form the basis for the transformation of spice procurement with further emphasis on responsible sourcing. The ongoing spice specification harmonisation together with a network for procurement upto farmer level will lead to a strong harmonized global sourcing of spices.

CHAPTER 03

Spices Processing

Spices are high value crops and processing operations are vital to maintain quality of spices to the specifications of international standards.

Various processing operations not only aid in keeping quality of spice flavours but also help control contamination levels of spices and spice products. Spices processing can be broadly divided into two stages, Post Harvest Handling and Primary Processing.

Post Harvest Handling

At the time of harvest, spices are considered to be semi-perishable and perishable in nature. It is important to process spices to enhance shelf life and minimize post-harvest losses. Generally, post-harvest handling operations include washing, pre-treatments, drying, cleaning and grading for specific quality and standards.

Washing

Pre-Treatment

Drying

Cleaning

Grading

Washing: Spices are washed in order to remove the adhering mud, dirt and microbial load, especially for roots and rhizomes which are dug out from the ground.

Pre-Treatment: Spices are subjected to various additional treatments in form of blanching, curing and certain chemical treatments.

Blanching: Inactivation of enzymes within the spices by using water under 100°c

Curing: Involves the suberization of the skin and development of wound periderm to prolong shelf life

Chemical Treatment: This includes use of alkali treatments, antioxidant treatments and bleaching.

Drying: Significant decrease in moisture content is achieved through drying. Generally, either sun drying or mechanical drying is employed in the case of spices.

Cleaning: Removal of extraneous matter which is adhered to the spices. It can be carried out manually by means of winnowing and use of blowers or by using mechanical cleaners

Grading: Allows standardisation and uniform quality in spices based on physical characteristics such as size, shape, colour or bulk density

Primary Processing

On a large scale, primary processing employs the operations of cleaning, grinding and certain post-processing treatment to enhance the quality of the spice as per specifications of international trade

Cleaning | **Grinding** | **Post Processing Treatment**

Cleaning

Using the difference in certain physical parameters between the spice and foreign material, specific cleaning equipments are used to remove the unwanted material from the spice. Generally, the basis of separation is shape and density as the physical parameter for cleaning operations.

Grinding

Grinding of spices produce different particle size distribution (PSD) depending on the choice of grinder and spice quality. Grinding aids to bring the spice to its desired granularity and opens up the aroma containing glands.

Post Processing Treatment

Once the spice is in its finished form, certain treatments are applied to reduce the microbial load in spices. High microbial loads can significantly decrease the shelf life of the spice, especially in cases wherein no heat processing is applied. These treatments can be applied to the spice in whole or ground form. Common treatments applied to spices include Steam sterilization, Ethylene Oxide Treatment and Irradiation.

Steam Sterilization: Application of high temperature steam to whole spices in order to surface sterilize the spice. It involves the spice being exposed to heat and moisture to the extent that quality of spice is not affected.

Irradiation: Packaged spices are exposed to irradiation sources for a predetermined time, resulting in sterilized spices with no off flavours or hazardous residues.

Ethylene Oxide Treatment (ETO): Spice is treated with ethylene oxide in an air evacuated sealed chamber. Ethylene oxide has the potential to kill insect eggs laid in or on the spice and prevents these pests from hatching by creating favourable conditions. However, Ethylene Oxide is considered to be a carcinogen and hence is currently approved only with certain residue limits in many countries.

CHAPTER 04

Science of Spices

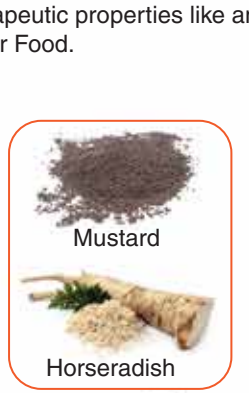
The recent popularity and increased use of spices has been a precursor for increased scientific research to advance the knowledge on spices.

The renewed interest in spices focuses on Nutrition, Health and Wellness with increasing number of scientific studies on the specific functional compounds and of future applications of spices. Each spice contains different active components and it is necessary to understand the characteristics of each component in order to make full use of its effect.

The contribution of spice towards the taste, aroma and colour along with the different sensations helps to create an impression that the brain has been trained to interpret as a particular food, smell, or flavour. This together with the therapeutic properties like antioxidant and antimicrobial makes spice a Super Food.

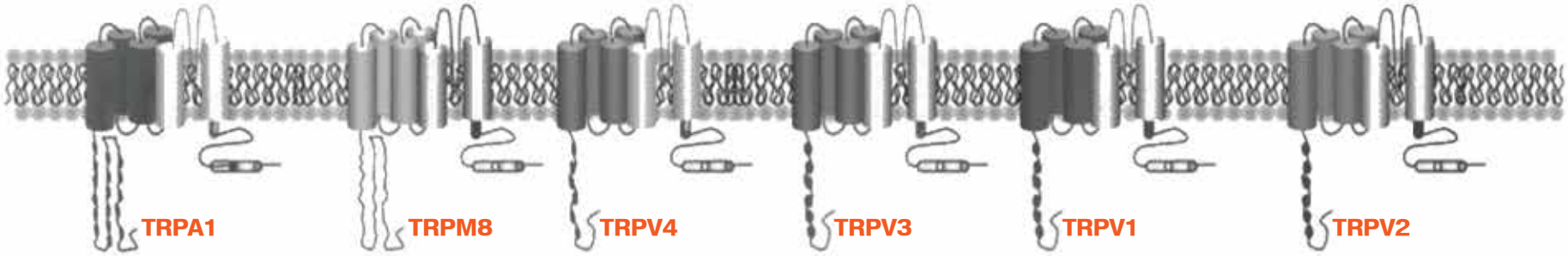
Sensing the Spices

Consumption of spices give way to sensations from warming or tingling to stinging and intense burning. Despite the burning sensation of Chilli Peppers or the rapid onset and offset of the pungency of Horseradish, there is a tendency to enjoy such sensations varyingly across the consumer population. So, the question arises, what really makes us perceive the spices in such a way? Why do we look forward to enjoy these effects? To believe that taste is driven by only what is experienced by our tongue and nose is an oversimplification. It is essentially the chemical sensitivity of the body that serves beyond the senses of taste or smell. Chemical compounds in spices evoke tactile and thermal sensations as well as many varieties of sensations which are induced through the stimulation of Thermo-Transient Receptor Potentials (TRPs). Among the TRPs, the three prominent receptors associated with spices are TRPA1, TRPV3 and TRPV1.



Thermo-transient receptor potentials (TRPs), a family of ion channels expressed at the endings of trigeminal nerve fibres exhibit sensitivity to change in temperature and chemical substances and activation of these receptors leads to the sensation of the according temperature change (Laura Vay et al., 2012)

Six thermo-TRPs have been characterized to date: TRP vanilloid (TRPV) 1 and 2 are activated by painful levels of heat, TRPV3 and 4 respond to non-painful warmth, while TRP ankyrin (TRPA) 1 is activated by painful cold



Responds by inducing cold sharp sensations by involving in a speculated interaction with TRPV1 co-expressed in the same sensory neurons

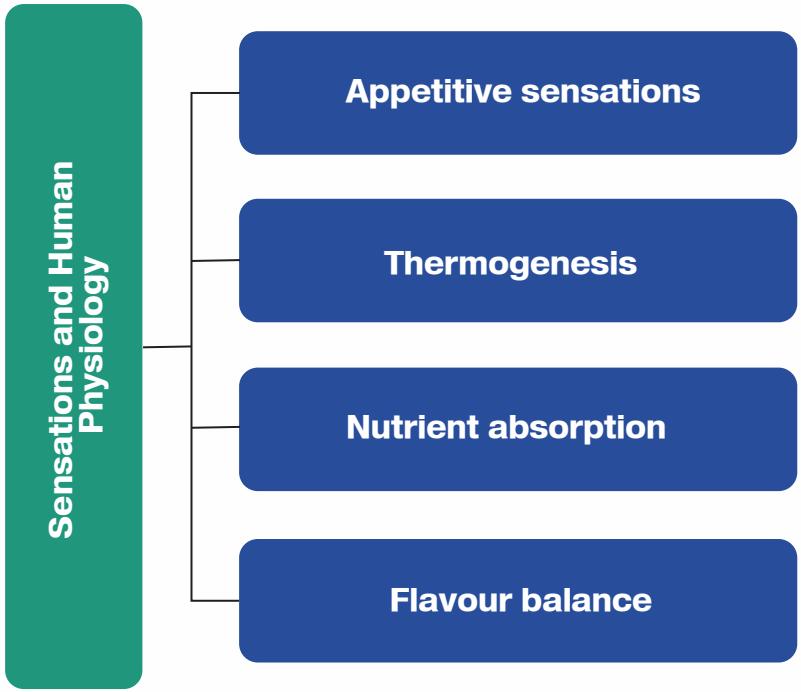
Expressed in keratinocytes and sensory neurons and is activated by innocuous warming into the noxious range

On activation, neuronal depolarization occurs leading to sensitization in the form of heat and burning sensations.

Temperature sensitive TRP sensors along with the temperature at which it begins to respond to heating or cooling relative to skin temperature

What do sensation of spices mean to us?

Multiple hypothesis link sensations and human physiology mainly to appetitive sensations, body temperature regulation (thermogenesis), nutrient absorption and flavour balance.



Fullness has been linked to cholecystokinin (CCK), glucagon-like peptide-1 (GLP-1), and peptide YY (PYY), among many other gut peptides (Hameed et al., 2009). Capsaicin prompts the release of gut peptides associated with satiety, such as GLP-1. Oral exposure can further activate the sympathetic nervous system, leading to the hypothesis that augmented fullness could also be attributable to elevated catecholamine concentrations.

Consumption of pungent spices is often linked to enhanced thermogenesis (i.e. augmented energy expenditure and/or substrate oxidation). The leading explanation for the thermogenic effects of spices is stimulation of the sympathetic nervous system by the binding of pungent compounds to thermosensitive ion receptors, namely TRPV1 and TRPA1 (Eldershaw et al., 1994; Okumura et al.,2010). Through this mechanism, the pungent principles of the spices stimulate the secretion of catecholamines from the adrenal medulla (Kawada et al., 1988 ; Yoshioka et al.,1995).

The use of pungent spices can even result in nutrient absorption based on the anorexigenic and thermogenic effects, inhibition of pancreatic enzyme activity and augmented metabolic rate. Capsaicin and piperine stimulate the activity of enzymes at the intestinal brush border membrane and increase microvilli length thereby increasing the absorptive surface, which is desirable for nutrient absorption (Prakash and Srinivasan, 2010).

The contribution of ‘sensation-inducing’ ingredients to the overall liking of flavours of food are significant as they impact overall flavour balance. They often have unique and pronounced temporal effects on overall sensory experience. They play an important role in developing “craveability” and providing new, authentic, and highly liked “experiences” for consumers. As product developers, we want to create craveable products that keep consumers engaged and satisfied without becoming monotonous as consumers like contrasting, dynamic textures and sensory experiences in general. Compounds such as capsaicin in Chillies can create a progression of flavour (a gradual onset and increase of burn, and slow drop off) that keeps the consumers’ senses piqued. A complex balance of heating, astringency and cooling with the use of a variety of spices makes for a very craveable sensory experience. You may thus consider these sensations equal to the impact of taste and smell on the linking of a product.

Therapeutic Properties

Spices have an overall beneficial impact on the food as various compounds contained in spices have been linked to having antimicrobial and antioxidant properties along with certain other properties that could have a possible positive effect on human health as mentioned in NHW Landscaping.

Antimicrobial Function of Spices

Antimicrobial Functions have been linked to the presence of Phenols, Sulfur Compounds and Terpenes and it's derivatives in spices. They have been proven effective against both gram positive and negative bacteria.

Spice	Effective Component	Microorganisms
Chilli Pepper	Capsaicin	Molds, Bacteria
Clove	Eugenol	E.coli 0157:H7, S.Aureus, Yeast
Ginger	Gingerol	E.coli, B.Subtillis
Coriander	Dodecenal	Salmonella
Mustard	Allyl isothiocynate	E.coli, Pseudomonas

Clove is one of the most valued spices in terms of its antimicrobial activity. Clove has shown great potential in inhibiting the growth of gram positive and negative bacteria. This is primarily due to its major bioactive component eugenol. Eugenol significantly damages the cell wall and membrane of the bacteria by inducing cell lysis through leakage of lipid and protein content.

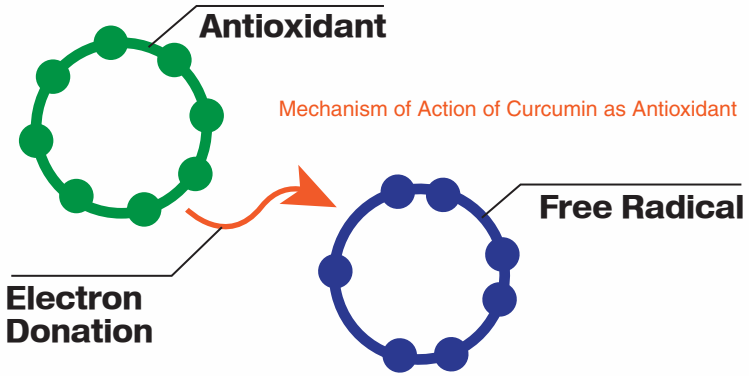
Cinnamaldehyde, a non-phenolic compound found in cinnamon, shows antimicrobial properties by inhibiting amino acid decarboxylase activity. The carbonyl group in cinnamaldehyde is responsible for the inhibitory action. The active ingredient has the potential to retard the formation of amines in formulated food products and, therefore considered as effective food preservative.

Antioxidant Function of Spices

Antioxidant functions of spices have been linked to the presence of flavonoids, polyphenols, terpenoids and lignans. Spices contain natural antioxidants that play a vital role in inhibiting degradation of food material.

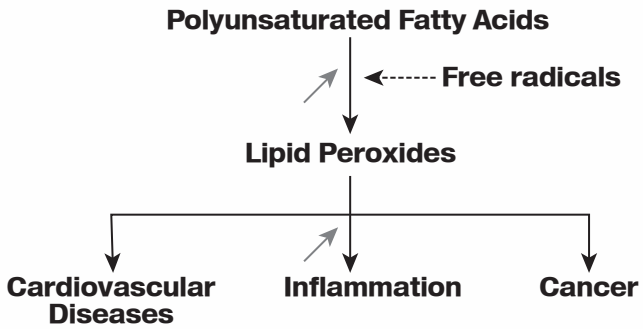
Spice	Major Antioxidants
Chilli Pepper	Capsaicin, Capsaicinol
Clove	Eugenol, Gallates
Ginger	Gingerol, Diarylheptanoids
Turmeric	Curcumin
Black Pepper	Phenolic Amides. Flavonoids

Turmeric is one of the most important spices for its wide range of therapeutic properties. The major active component curcumin is known to protect bio-membranes from peroxidative damage. Curcumin is a unique antioxidant consisting of a variety of functional groups with the phenolic group and central methylenic hydrogen group being of most importance. These functional groups are attributed to be essential for the free-radical-scavenging activity and make curcumin an excellent H-atom donor.



Mechanism of Action of Curcumin as Antioxidant

Oxidative damage at the cellular and subcellular level is considered to be an important event in disease processes like CVD, inflammatory disease, carcinogenesis, and ageing. Lipid peroxidation in human erythrocyte membranes can be inhibited by the active components like eugenol (Clove), capsaicin (Chilli). These compounds inhibit lipid peroxidation by quenching oxygen free radicals and by enhancing the activity of endogenous antioxidant enzymes - superoxide dismutase, catalase, and glutathione peroxidase and glutathione transferase (Mekha et al., 2014).



Mechanism of Action of Capsaicin and Eugenol as Antioxidant

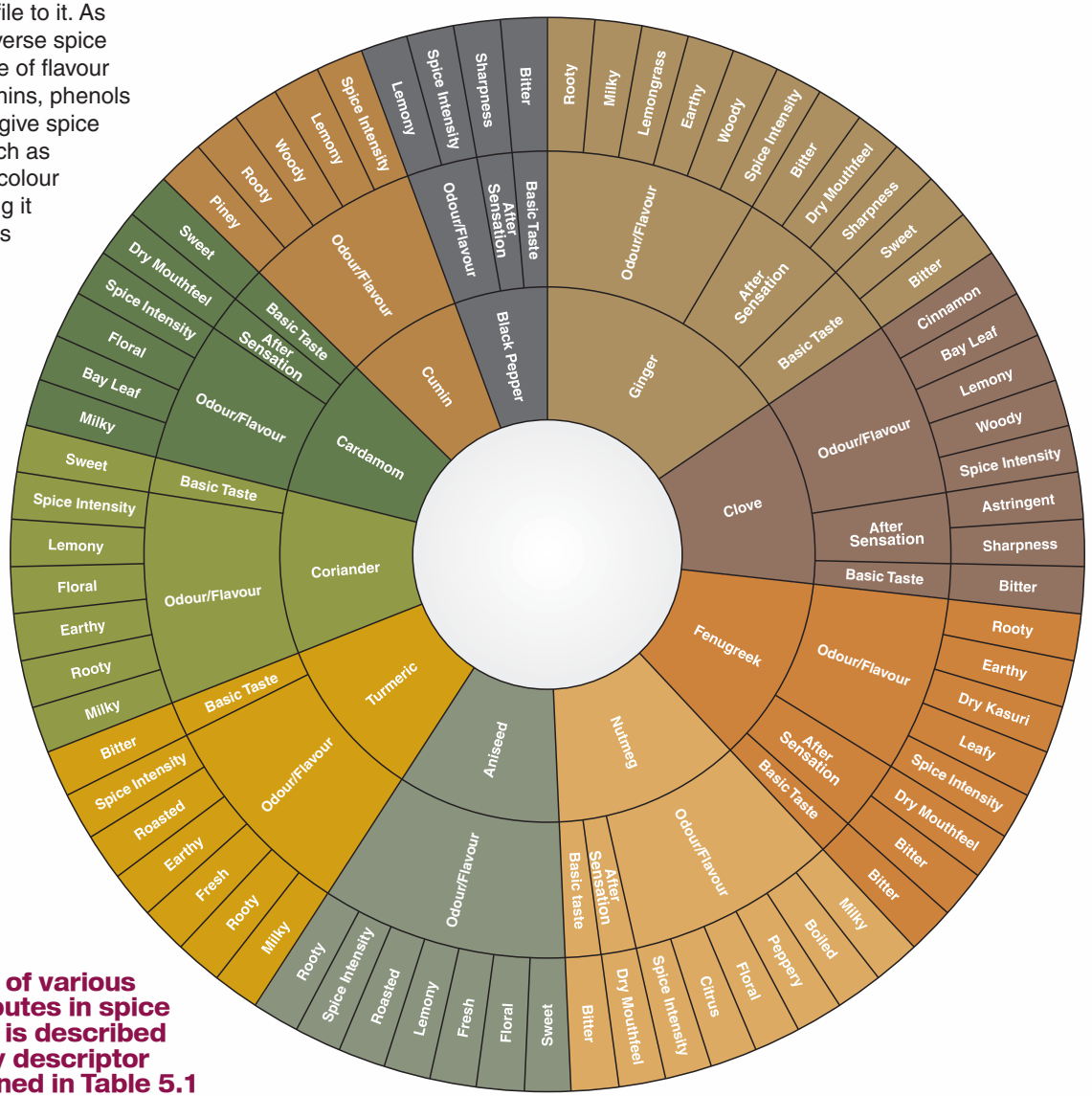
CHAPTER 05

Sensorial Landscape

Spices play a substantial role in providing diverse flavour profiles in food products, along with other sensory attributes such as appearance, mouthfeel etc.

Spices typically have more than one flavour profile to it. As mentioned in Chapter Science of Spices, the diverse spice flavours are attributed to the presence of a range of flavour compounds like aldehydes, ketones, esters, tannins, phenols etc. The balance of these chemical compounds give spice its characteristic flavour profile. Some spices such as Saffron, Paprika, Turmeric and Annatto provide colour as well as flavour to foods and beverages making it an ideal choice for natural colouring. Carotenoids are oil soluble, heat-resistant and include β-carotene, capsantin, and lutein. Flavonoids and anthocyanins are both water-soluble. Anthocyanins are known to impart red, pink or purple colour while flavonoids are yellow or yellowish-white. The behaviour of these colouring compounds in a food matrix are crucial and impact the overall colour it would impart on the food.

Spice Wheel



The Sensory Characteristics of Spices

To understand the flavour profile of spices a systematic approach of listing down the sensory attributes is essential based on sensory expertise and Gas Chromatography analysis data. A spice wheel describing various sensorial characteristics of select ten spices is illustrated in the spice wheel infographic. For example, Cumin has a lemony, woody, rooty, piney odour and flavour perception. Interestingly, roasting of spices bring about a change in these attributes; the green notes (like freshness and lemony) go down while the brown notes (woody and earthy) increase in roasted spices.

The definition of various sensory attributes in spice flavour wheel is described in the sensory descriptor list as mentioned in Table 5.1

Table 5.1
Definition of Sensory Descriptors

APPEARANCE

Colour	Intensity of the colour. A very intense colour looks strong and vivid, in the contrary; a less intensive colour looks pale.

ODOUR & FLAVOUR

Spice Intensity	Overall intensity of respective spice. (weak-strong)
Roasted	Dark brown impression characteristic of products cooked to a high temperature by dry heat. Does not include bitter or burnt notes. Associated with attributes such as toasted, nutty and sweet.
Burnt	The dark brown impression of an over-cooked or over-roasted product that can be sharp, bitter, and sour.
Woody	The sweet, brown, musty, dark aromatic associated with a bark of a tree.
Rooty	A somewhat dark, musty and earthy, reminiscent of dark fruits and root vegetables such as beets and carrots
Bay leaf	Intensity of characteristic Bay Leaf spice
Spicy	Intensity of Allspice attributes perceived, independent of individual characteristic notes.
Sweet spicy	The sweet, brown aromatic associated with spices such as Cinnamon, Clove, Nutmeg, and Allspice.
Milky	Intensity of directional dairy (milk like) odour and flavour
Grassy	A green aromatic associated with newly cut grass and leafy plants, characterized by a sweet and pungent character
Lemon grass	Intensity of directional lemon grass odour and flavour
Citrus	A citric, sour, astringent, slightly sweet, peely, and somewhat floral aromatic that may include Lemons, Limes, Grapefruits, or Oranges
Floral	A sweet, light, slightly fragrant aromatic associated with fresh flowers.
Earthy	The somewhat sweet, heavy aromatic associated with vegetation and damp, black soil.
Fresh	An aromatic characteristic of fresh, plant-based material. Attributes may include leafy, viney, unripe, grassy, and peapod.
Salty	Intensity of basic taste salt
Sweet	Intensity of basic taste sweet
Sour	Intensity of basic taste sour
Bitter	Intensity of basic taste bitter

AFTER SENSATIONS

Dry mouthfeel	Intensity of dry mouth feel after swallowing the product
Astringency	The complex sensation of shrinking, numb and furry or puckering in the mouth
Sharp	Hitting pain perceived in throat immediately and burning after sensation.
Hot	Pain, perceived as tactile sensation, like heat in the mouth. Very persistent.

Modality	Method of preparation of samples	Evaluation protocol
Appearance	Weigh 2g sample in white bowl	Evaluate the samples in white bowl
Odour	2g powder in 100ml conical flask	Gently open the cork
	Put the stopper	Do short sniffs
	Evaluate the samples after 15mins (volatiles needs to collect near the neck)	Take a break of 10s before evaluating next sample/ smell fresh coffee beans
Flavour	Weigh 1.5g of corn starch and 0.25g Salt to the sample*	Evaluate the solution
	Add 100ml of cold water (hot water may cause lumping)	Take spoon full of sample and swirl in mouth
	Stir the solution	Have apples/warm water in between two samples
	Cook for 1.5min in an open pan	

*Individual spice sample quantity for sensory evaluation:
Black Pepper - 0.1 g | Clove, Nutmeg - 0.25 g | Cumin, Ginger, Turmeric, Cardamom, Fenugreek - 0.5 g | Coriander -1.5 g | Aniseed - 2 g

Palate cleanser is used to remove residuals and prevent adaptation that may otherwise alter intensity ratings of any sensory attribute. Research examining relative efficacies of various palate cleansers on different food categories has been limited; a few palate cleansers are more effective than just rinsing with water. The palate cleansers used during the evaluation of spices are given in the table:

Name	Description	Purpose
Apples	FUJI Grade A	eating
Warm Water	40°C	drinking
Coffee Beans	Nose neutraliser	sniffing

Note: It is must to use palate cleanser between two samples in order to avoid carryover of heat, sharpness, bitterness and specific flavour of spices.

A detailed sensory evaluation protocol is available in documentum and link is also available on intranet at Nestlé Spice Page

CHAPTER 06 Consumer Insights

The global food and beverage industry is witnessing rapid changes in consumer preference and dining habits.

The spices and herbs are at the centre of the food and flavour innovation which are driving these changes. Nestlé has done a consumer research to understand the consumer preference and perceptions on spices and herbs and also on roasting of spices. A few of the key learnings are abridged in this chapter.

Global top three spices

When it comes to spices, local preferences are evident largely due to the food tradition and availability of spices. However, Black Pepper, Red Chilli and Cinnamon are found common across geographies in terms of preference and hence they are the top 3 most used spices at global level. Some of the other spices such as Clove, Cumin, Ginger and Paprika also have global significance though they have greater regional preference. It is also noteworthy that in countries which have a long traditional spice usage, like India and China, the key spices show a different trend.

TOP Spices Consumed Snapshot at Individual Country Level

MEX
Black Pepper
Cinnamon
Cumin
Clove
Red Chilli

COL
Cinnamon
Cumin
Clove
Black Pepper
Ginger

DEU
Black Pepper
Nutmeg
Cinnamon
Paprika
Cumin

FRA
Black Pepper
Cumin
Cinnamon
Ginger
Clove
Red Chilli

POL
Black Pepper
Nutmeg
Cinnamon
Paprika
Cumin

MEA
Black Pepper
Cumin
Paprika
Red Chilli
Cinnamon

IND
Black Pepper
Ginger
Clove
Green Chilli
Turmeric

RUS
Black Pepper
Paprika
Red Chilli
Cinnamon
Clove

CHN
Star Anise
Szechuan Pepper
Cassia (Cinnamon)
Ginger
Cumin

PHL
Black Pepper
Red Chilli
Ginger
Paprika
Turmeric
Cardamom

MOST PROMINENT ARE BLACK PEPPER, CINNAMON AND RED CHILLI

Across countries, 3 common spices stand out, but China and India show quite specific profiles.

Consumer Data is based on the Quantitative Research conducted in 10 Countries (Germany, France, Poland, Russia, Mexico, Colombia, India, Philippines, China and Middle East with a sample size of 600 each country.)

Black Pepper

PROFILE
Very consensual, Black Pepper is equally used across gender, age and cooking segments.

DISHES
Black Pepper is associated to hot/cold dishes as well as dressings.

FORMAT
Usage:
Powder, Whole

PREPARATION
It is mostly used while cooking as it is mixed (esp. RUS, LATAM, MEA, FRA and South-East Asia).

PERCEIVED BENEFITS
Black Pepper's benefits are related to enhancement (enhances the taste, increases the level of spiciness) It is perceived to be very versatile (can be used to any dish), but not very differentiating (except in MEX).

REASONS NOT TO PURCHASE
Black Pepper does not suit everyone.

What to do?
Communicate possible usage in multiple dishes and dressings as well as the benefit in improving taste and spiciness.

Introduce different varieties of Black Pepper to drive differentiation.

There might be merit in indicating the level of spiciness as Black Pepper could become polarizing.

Cinnamon

PROFILE
More used by woman (EU) or older target in India.

Enthusiastic (DEU and CHN) and Efficient (CHN).

DISHES
It is associated to pasta, rice and cold sauces

FORMAT
Usage:
Powder Mainly in EU and PHL.
And is purchased in single pack sachet.

PREPARATION
It is mostly used while cooking As it is mixed (esp. RUSE, LATAM, MEA, FRA and South-East Asia)

PERCEIVED BENEFITS
Cinnamon enhances the smell of dishes and allows creativity.
It is also associated to emotional benefits (childhood).
And it has a calming effect.

REASONS NOT TO PURCHASE
Cinnamon can only be used in a limited range of dishes.
It is not easy to integrate it in day to day dishes.
Not everyone likes it.

What to do?
In EU communicate towards women and in China Enthusiastic/Efficient cooks with recipes and/or products that trigger emotions (togetherness, childhood memories etc.) and leverage calming benefit.

Suggest a few relevant and new dishes to inspire consumers.

Red Chilli

PROFILE
Red Chilli is more used by Mels (COL/MEA) and 45-55 (DEU and POL)

Efficient (FRA) and Enthusiastic (DEU/COL)

DISHES
It is mostly used in hot dishes and very much associated to roasting

FORMAT
Usage:

Powder, Fresh

PREPARATION
It is mostly used as it is, or chopped, or minced.

Red Chilli is primarily included in the dish while cooking.

PERCEIVED BENEFITS
Red Chilli enhances the taste of dishes
It is proaised for its versatility (Plan/China) and helps being creative
Adds a personal touch, energitign (CHN, MEA)
Adds colour to dishes (PHL).

REASONS NOT TO PURCHASE
It does not suit the taste of the whole family.
Can be used in a limited range of dishes (MEX).

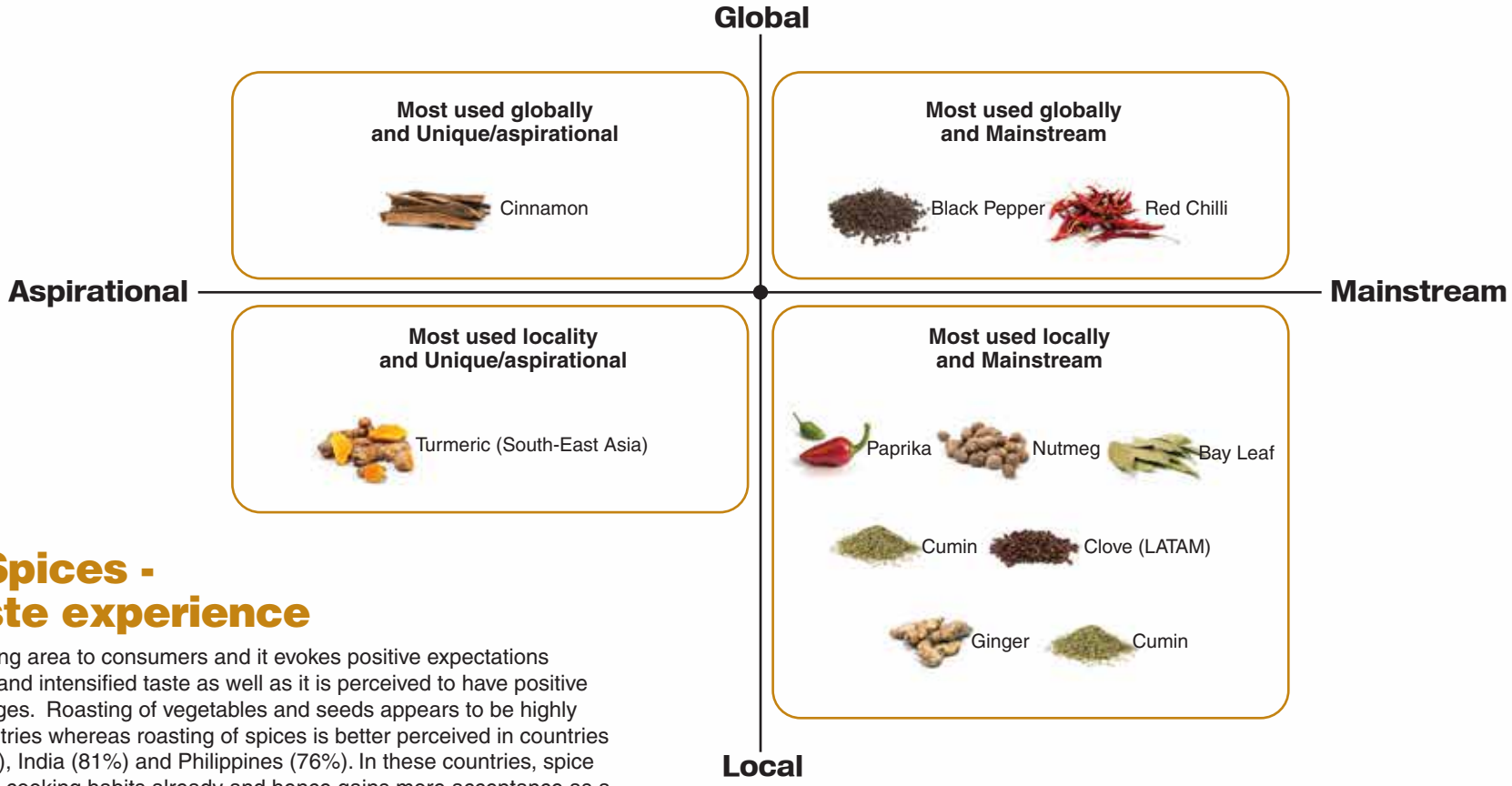
What to do?
Leverage versatility with the limit of strength acceptability; indicate the level of strength to reassure with family/guests.

For some specific recipes, play on the polarizing/differentiation aspects(for those who like them hot etc.)

In PHL, play colourfulness and visual appeal on pack

Mainstream and Aspirational Spices

At a global level of top spices, Cinnamon was seen as more aspirational largely due to the exotic nature of the spice. It also triggered childhood memories among consumers surveyed. Black Pepper and Red Chilli were seen as more mainstream. At local level, variations were noticed for spices for aspirational vs mainstream.



Roasted Spices - A new taste experience

Roasting is an appealing area to consumers and it evokes positive expectations towards an enhanced and intensified taste as well as it is perceived to have positive smell and colour changes. Roasting of vegetables and seeds appears to be highly appreciated in all countries whereas roasting of spices is better perceived in countries especially China (93%), India (81%) and Philippines (76%). In these countries, spice roasting plays a role in cooking habits already and hence gains more acceptance as a cooking technique. European countries have registered average positive perception (37-50%) towards roasting of spices.

Roasting of spices may also evoke negative perceptions with respect to the burning factor, leading to burnt flavour and dark colour, especially in the powder spice format. Any potential effort in product communication should focus sensorial benefits, highlighting single spice / spices that have been roasted.

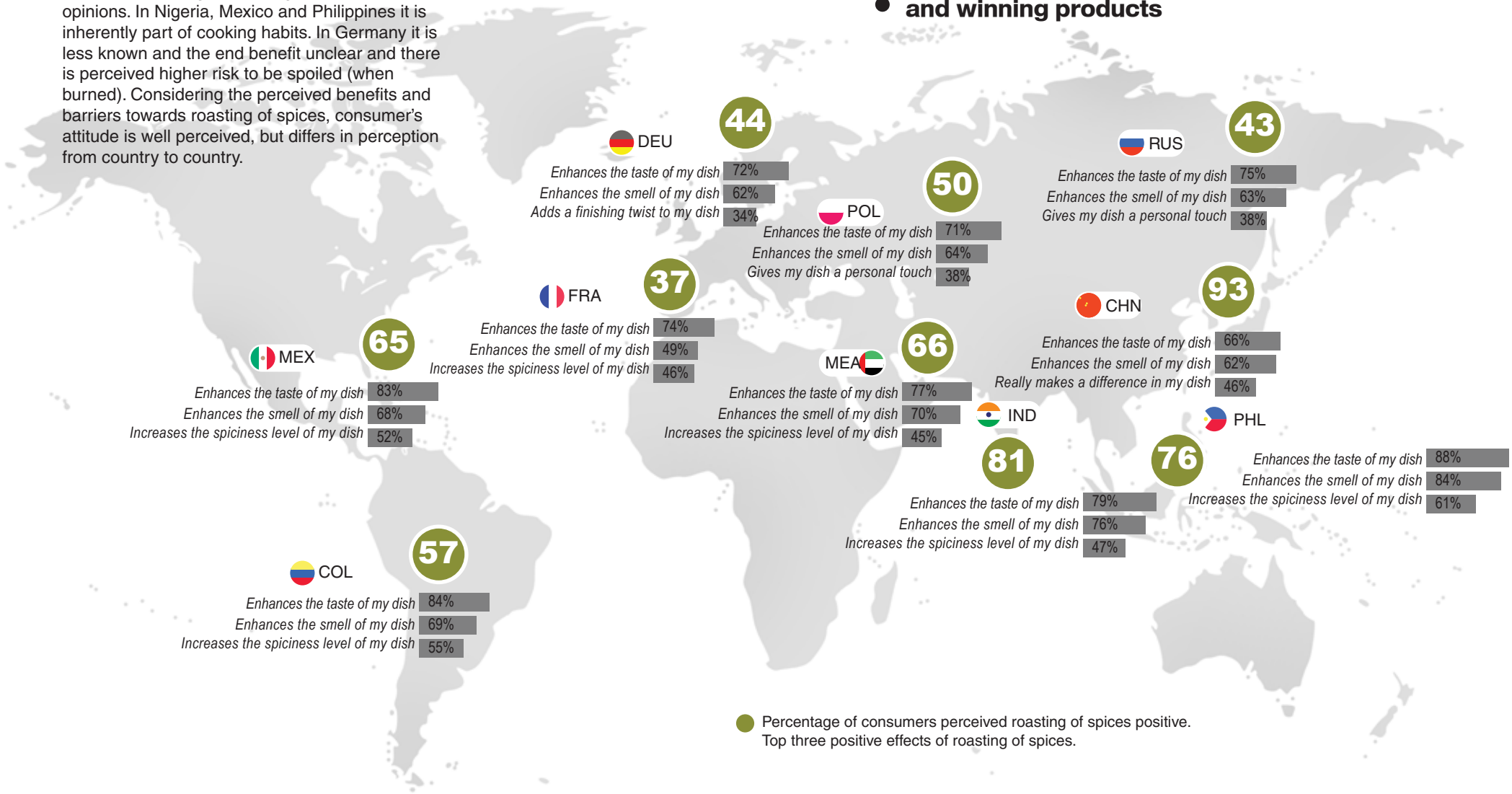
Consumer Perception on Roasting of Spices

Roasting is perceived to enhance the sensorial experience of the meal, which is the key trigger of consumers' interest in roasted ingredients in products. Roasting of spices generates polarized opinions. In Nigeria, Mexico and Philippines it is inherently part of cooking habits. In Germany it is less known and the end benefit unclear and there is perceived higher risk to be spoiled (when burned). Considering the perceived benefits and barriers towards roasting of spices, consumer's attitude is well perceived, but differs in perception from country to country.

ROASTING Adds value to products

VEGETABLES, SEEDS & NUTS is a promising territory

ROASTING OF SPICES is a critical area which demands mastership to create differentiated and winning products



Percentage of consumers perceived roasting of spices positive.
Top three positive effects of roasting of spices.

Factors driving consumer perception towards spices

Globally consumers expect 'level of spiciness' as the most important factor for consideration, when buying spices followed by 'ecofriendly manufacturing' in European region and Latin America, while Asia Pacific region expect 'organic origin' as second factor followed by 'ecofriendly manufacturing'. Consumers also expect Taste (76%) as the key benefit from spices followed by Health (70%) and Aroma (69%). The taste and aroma perception can be attributed to either enhancement or balancing, whereas, healthiness is anchored around prevention of diseases in Eastern Europe, Middle East Asia and South East Asia. Diet has been found more relevant in LATAM and China due to increased exposure to weight control messages in relation to spices.

CHAPTER 07

Chef's Insight on Spices

Top spices used across regions

Spices are essential element in cuisines since time immemorial, whether it is about adding taste, texture or intensity of character. While consumption of spices is generally higher in Asian countries such as India, China, and Thailand, there has been an increasing trend in their intake in developed countries such as in Europe and the USA, because of changing food habits and preference for ethnic and spicy food. As mentioned in Consumer Insight chapter, Black Pepper, Red Chilli and Cinnamon are the top three most used spices at global level.

The spice usage also depends on the seasons and climates. The people living in warm climates tend to prefer hot, spicy foods whereas those in milder regions more often embrace blander flavour. Though this notion is on the decline due to the globalization of international cuisines, the link between a nation's ambient temperature and its effect on the spice levels may be more than a culinary stereotype. There have been many citations based on researches saying that capsaicin's artificial heat triggers real perspiration, in the process effecting evaporative cooling and making life more comfortable for those living in hot climates.

Source: Nestlé Chef's Network

Spice blends used across regions

AFRICA

- HARISSA
  Made form smoked red peppers

  Used in Tunisia and other North African Countries

- DUKKAH
  Mix of toasted nuts and seeds such as Hazelnuts, Sesame Seeds, Coriander and Cumin

- RAS EL HANOUT
  Made from Nutmeg, Coriander, Cumin, Ginger, Turmeric and Cinnamon

  Used in Morocco and other North African countries

- BERBERE
  A combination of spicy, bitter and sweet spices.

  Made from Chilli Peppers, Garlic, Ginger and Basil.

  Used in Eritrea, Djibouti, Ethiopia and Somalia

ASIA

- GOMASIO
  Made from Toasted Sesame Seeds Ground with Coarse Salt

  Used in Japan

  Tastes best over rice

- TOGARASHI
  Mix of seven spices

  Made from Chilli pepper, Citrus Peel, Sesame Seeds and Seaweed.

  Used in Japan

- CHINESE FIVE SPICE
  Mix of pungent spices

  Gives dishes a balance of sweet, savoury, bitter and sour

  Made from Cinnamon, Clove, Fennel Seed, Star Anise and Peppercorns

  Used in China

EUROPE

- KHMELI SUNELI
  Mix of warm, nutty, grassy and bitter spices

  Made from Fenugreek, Coriander, Savoury and Black Peppercorns

  Used in Georgia

- QUATRE EPICES
  Means "Four Spices"

  Made from ground black and/or White Pepper, Cloves, Nutmeg and Ginger

  Used in France

Spice blends form the core of many cuisines across the world. These blends are premixes of specific spices which are then mixed to create a signature flavour sensation of a region. We can find quite a few spice blends across continents and these spice blends add the signature flavour to the regional cuisines. For instance, Harissa is a classic spice blend in the Maghreb region of North Africa. It contains smoked Chilli Peppers along with Garlic Coriander and Caraway. Harissa finds usage in dip, sauce or marinade. Similarly, Garam masala is a classic spice mix found throughout in Indian subcontinent. Many regional cuisines use this spice mix for the bold subcontinent flavour. A typical Garam masala contains Black Pepper, Cumin, Cinnamon, Clove, Nutmeg, Bay Leaf and Green Cardamom. These classic spice blends serve as an excellent inspiration for the various culinary innovation and renovation projects.

Source: Health Perch and Ghergich & Co

Spice blends used across regions

Chef's Insight on Spices

LATIN AMERICA & CARIBBEAN

- ADOBO
  All purpose seasoning

  Made from Garlic, Oregano, Pepper and other spices

  Used in Mexico and Latin America

- ERK SPICE
  Made from Red and Black Pepper, Allspice, Cinnamon and Thyme

  Used in Jamaica

- CHILLI POWDER
  Made from Ancho Chile, Paprika, Cumin and Mexican Oregano

  Used in Latin America

MIDDLE EAST

- BAHARAT
  All purpose seasoning

  Made from Black Pepper, Cumin, Cinnamon and Cloves

- ADVIEH
  Mix of Dried Rose Petals and spices like Cinnamon, Cardamom, Cloves, Nutmeg and Cumin

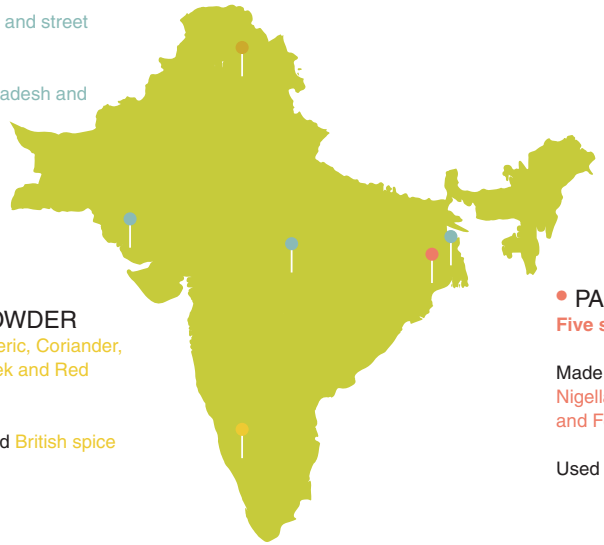
  Often used in rice and stews

  Used in Iran and other Persian countries

- ZA'ATAR
  Mix of Thyme, Sesame Seeds and Sumac

  Used primarily in the Middle East

INDIAN SUBCONTINENT



- CHAAT MASALA
  Made from Amchoor (dried mango)

  Sprinkled on snacks and street foods

  Used in India, Bangladesh and Pakistan

- GARAM MASALA
  Garam means warm or hot mix of warming spices

  Made from Cinnamon and Cardamom

  Used in North India and South Asia

- CURRY POWDER
  Made from Turmeric, Coriander, Cumin, Fenugreek and Red Pepper.

  An Indian inspired British spice

- PANCH PHORON
  Five spice blend

  Made from whole Fenugreek, Nigella, Cumin, Black Mustard and Fennel Seeds

  Used in Bengal

Usage Formats

The unique fact about the spices is that different flavours can be extracted from the same spice by using different methods of using like grinding, roasting, adding the whole spice or by combining the spice with other spices. Traditionally spices have been used over the years in different countries in different forms and formats. The formats, largely depending on culture, availability and their usage in cooking, has given us an insight on the opportunities on where and how they can be used. For example, some spices are cracked just to cover more surface area for dry heating or oil tempering, some are dry broiled just to bring out their flavour before grinding and some are simply dried under sun for ease of grinding because of reduction in moisture. Depending on the culture and tradition of that country or region, spices are diversely used across continents.

Spice Usage Formats in Culinary Art

Format	Usage	Spices	Culinary Benefit
Whole	Used to start up the cooking process and are heated in the oil to get spiced aroma. In many cuisines, the flavour should be there and not whole spices as they fill your mouth with one particular taste if bitten and so you cannot relish the food as a whole.	Cinnamon, Cardamom, Clove, Cumin, Bay Leaf, Peppercorns, Red Chilli, Nigella, Mustard, Caraway	Visual appeal and unique texture.
Cracked	Cracked into irregular small pieces with sauce pan or pestle. Used commonly in baking, marination, stewing and garnishing.	Black Pepper, Cumin, Coriander, Fennel	Intense release of flavour than whole.
Ground	Majorly used in marinations and also used in the end of a curry to add top notes. Also used for giving texture to a gravy.	Curry powder, Five spices powder, Most spices	Better release of flavour. Interacts well with other aromatic ingredients. Allows controlled dosing at various stages.
Roasting	Dry roasting is a process by which heat is applied without the use of oil or water, in a frying pan or wok. Spices are roasted individually or in a sequence to achieve a defined impact on the flavour profile.	Cumin, Fenugreek, Coriander	Enhances the taste and aroma of a particular spice and sanitizes the ingredient. Helps to mellow bitterness.
Tempering	Oil is heated close to smoking point and the whole ingredients are added in sequence, based on sensitivity to heat. Some spices may pop. The heated oil with the ingredients is then added to the dish as a finisher or this step is done as the first step of the cooking of the dish. The kind of oil influences the flavour.	Mustard, Cumin, Fenugreek, Red Chilli, Curry Leaf	Unique flavour profile ranging from smoky to slightly burnt and nutty.
Extraction	The process of obtaining the flavour compounds of spices into a dish by steeping them in oil, water or wine for a certain time or heating the mix to extract the flavour compounds better.	Fennel, Fenugreek, Saffron, Ratan Jot, Szechuan Special Pepper, Red Chilli, Tamarind, Kokum, Dry Mango	Infusion flavour and colour in oil or water.
Finishing	Used in very small quantities especially on snacks. Flavoured oil or a special blend of aromatic spices can be used.	Aromatic spices, White Pepper, Szechuan Special Pepper, Red Chilli, Ginger	Freshness and top note.

Art of Spice Pairing

Knowing how to use spices is the key to drive value out of it and food pairing is quintessential in that knowledge framework. Spices allow the user to be creative and adventurous while making sure the meal is not bland. Culinary pairing is not only about the knowledge and skill, but also about experimenting. One of the most important thing to ensure is to use ingredients that are complimentary in nature. Opposite flavours may not be so flavourful. Bold flavours, such as Balsamic and Fig, pair nicely, while soft and subtle Ginger and Plum match well. The things which need to be considered are intensity and direction of flavour, and flavour sensation among others. When different foods share certain key aromas they are more likely to pair well in recipe. Western cuisines show a tendency to use ingredient pairs that share many flavour compounds, supporting the so-called food pairing hypothesis. By contrast, East Asian cuisines tend to avoid compound sharing ingredients. The infographic illustrates traditional pairing of spices with other spices and other ingredients.

Spices and Herbs Pairing

Key Flavour Profile	Allspice Earthy, Sweet	Oregano Earthy	Cinnamon Earthy, Sweet	Cloves Earthy, Sweet	Coriander Earthy, Peppery	Nutmeg Sweet	Basil Sweet	Paprika Sweet, Warm
Produce	Apples, Beets, Cabbage, Carrots, Squash, Sweet Potatoes, Turnips	Artichokes, Tomatoes, Bell Peppers, Zucchini, Potatoes, Mushrooms	Apples, Carrots, Pears, Sweet Potatoes, Squash	Apples, Beets, Squash, Tomatoes, Sweet Potatoes,	Bell Peppers, Potatoes, Onions, Tomatoes	Broccoli, Cabbage, Carrots, Squash, Cauliflower, Sweet Potatoes	Bell Peppers, Eggplant, Potatoes, Tomatoes, Zucchini	Bell Peppers, Squash, Cauliflower, Broccoli, Potatoes
Protein	Beef, Lamb	Beans, Chicken, Fish, Lamb, Pork	Chicken, Lamb	Lamb	Chicken, Beef, Fish, Pork, Tofu	Lamb	Cheeses, Chicken, Fish, Pork	Chicken Shellfish, Lamb, Tofu
Use in	Soups, Desserts, Breads	Soups, Salad Dressings, Tomato Sauces, Dry Rubs, Marinades	Fruit Sauces, Desserts, Breads	Curries, Soups, Marinades, Desserts, Breads	Curries, Soups, Sauces, Stuffing, Dry Rubs, Marinades	Rice, Stuffings, Sauces	Salad Dressings, Sauces, Dry Rubs, Marinades	Rice, Soups, Salad, Dressings, Marinades
Pairs well with	Cardamom, Nutmeg, Cinnamon, Cloves, Ginger, Mace	Chilli Powder, Bay Leaves, Thyme	Allspice, Cloves, Nutmeg	Cinnamon, Nutmeg, Allspice, Basil	Chilli Powder, Cumin, Cinnamon	Allspice, Cloves	Garlic Powder, Rosemary, Thyme, Marjoram, Oregano	Garlic Powder, Chilli Powder, Cardamom, Cumin

Bay Leaves Bitter	Cardamom Sweet	Cayenne Pepper Spicy	Cumin Smoky, Earthy	Garlic Powder Savoury	Ginger Sweet, Warm	Rosemary Earthy	Thyme Earthy	Turmeric Peppery, Bitter
Potatoes, Tomatoes, Mushrooms	Carrots, Citrus, Corn, Peas, Sweet Potatoes, Sqaush	Eggplant, Potatoes, Zucchini, Bell Peppers, Corn, Tomatoes	Eggplant, Tomatoes, Zucchini, Carrots, Corn, Green Beans	Cabbage, Tomatoes, Zucchini, Carrots, Mushrooms	Carrots, Citrus, Sweet Potatoes, Beets, Squash	Mushrooms, Peas, Potatoes, Onion	Carrots, Tomatoes, Zucchini, Cauliflower, Green Beans, Peas	Cauliflower, Cabbage, Potato, Sweet Potatoes
Beans, Lentils, Shellfish	Chicken, Duck, Lentils, Pork	Chicken, Beef, Fish	Beans, Chicken, Beef, Fish, Lentils, Pork, Tofu	Beans, Chicken, Beef, Fish, Tofu	Chicken, Beef, Fish, Pork, Tofu	Beans, Chicken, Lamb, Pork, Fish	Beans, Chicken, Fish, Lamb, Pork, Lentils	Beans, Lentils, Chicken Fish, Tofu
Risotto, Soups	Curries, Rice	Rice, Soups, Salad Dressings, Sauces, Marinades	Curries, Rice, Soups, Sauces, Dry Rubs, Marinades	Curries, Soups, Sauces, Stir-Fries, Dressings, Dry Rubs, Marinades	Rice, Curries, Stir-Fries, Marinades	Marinades	Soups, Salad Dressings, Dry Rubs, Marinades	Curries, Rice
Oregano, Sage, Thyme, Marjoram	Cinnamon, Cumin, Ginger, Turmeric	Cumin, Paprika, Cinnamon	Garlic Powder, Turmeric, Ginger, Cinnamon, Oregano	Oregano, Cumin, Coriander, Turmeric	Garlic Powder	Garlic Powder, Oregano, Thyme, Basil	Oregano, Rosemary	Cardamom, Garlic Powder

Source: Cook Smarts

Signature Spice Recipes

Spices play a key role in the flavour of many cuisines around the world. Read on to discover more on the spice influence through some of the authentic dishes around the globe. The recipes of these dishes are shared in the appendix.

Chicken and Andouille Jambalaya

Jambalaya has its origins in Louisiana and is a rice based dish with similarities to Paella. This recipe is made with chicken and a Paprika spiced Andouille sausage although the dish often has crawfish or shrimp added. The flavouring of the rice is helped with the addition of spices like Cumin, Mustard, Coriander, Bay Leaves and Cayenne Pepper.

The Hungarian Goulash

Originating from the medieval Kingdom of Hungary, Goulash is also a popular meal in Central Europe, Eastern Europe, the Netherlands, Belgium, Switzerland, Scandinavia and Southern Europe. This hearty dish is based on beef, onion and vegetables. The flavour profile relies heavily on Paprika Powder and spices like Caraway, Bay Leaf and Black Pepper to lift the taste profile.

The Jerk Chicken

A classic spicy hot dish from Jamaica. 'Jerk' refers to a way that a food is seasoned and cooked which is the marination of several ingredients including spices Ginger, Cinnamon, Ginger, Nutmeg, Allspice and Scotch Bonnet Chillies. The chicken is then grilled over a wood or charcoal fire.

Pollo a la Brasa

Pollo a la Brasa (Roasted Chicken) is one of the most consumed dishes in Peru, Columbia and Brazil. The whole chicken is spice rubbed with ingredients including Chilli, Cumin, Paprika and Black Pepper. The chicken is then roasted and served with green herb sauce made with Chillies Aji Amarillo and Jalapeno.

Shawarma

Shawarma is an Arabic dish named after the rotisserie - cooked nature of the meat. It is made by alternately stacking strips of fat and pieces of seasoned meat on a vertical spit. The spices like Coriander, Cumin, Cardamom, Cayenne Pepper, Paprika and Black Pepper are used in seasoning. The meat is roasted slowly on all sides as the spit rotates in front of, or over a flame for hours. The meat is then shaved off the stack and made up into a sandwich wrap with pita or lavash together with pickled vegetables and Garlic Aioli.

Shepherd's Pie

A popular UK dish that has a minced lamb and vegetable base topped with potato and cheese. The version 'Cottage Pie' uses beef. The spices used in this recipe are Black Pepper, Bay Leaf and Worcestershire sauce which has Ginger, Mustard and Cinnamon in its ingredients.

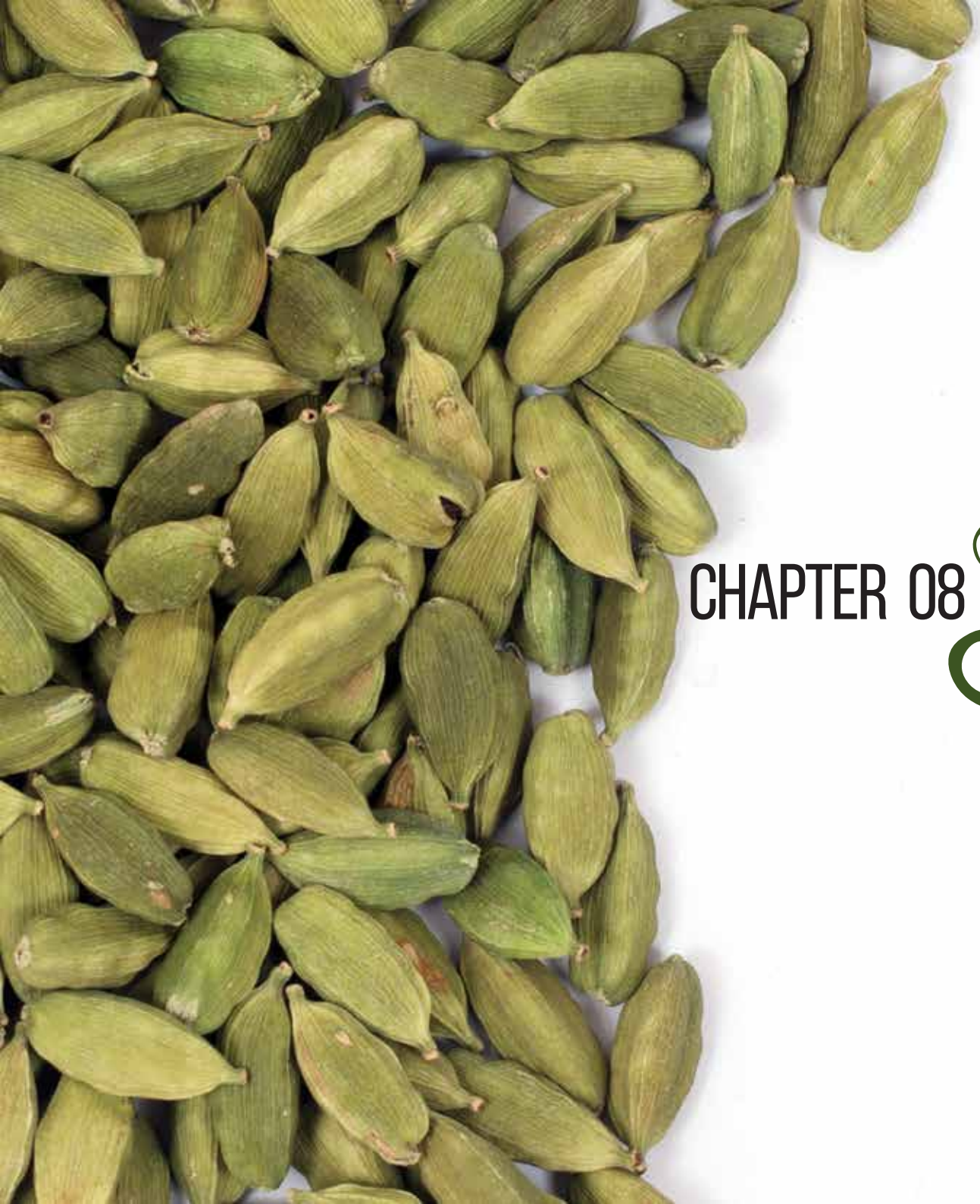
Alsatian Sauerkraut

A hearty classic dish form the east of France (Alsace) is traditionally based on pickled cabbage and various pork and ham cuts like Strasbourg sausage or frankfurters, bacon, smoked pork or smoked Morteau or Montbéliard sausages which are braised together.

The Alsace region has routes in the Germanic culinary traditions and this recipe version is flavoured with spices of Juniper Berries, Bay Leaf, Caraway Seed and Cloves.

The Lamb Tajine

A Tajine or Tagine is a Maghrebi dish which is named after the earthenware pot in which it is cooked. In North Africa it is called a Tajine (Persian language: large pot) or a "Maraq" (Arabic language: "Broth"). There are different ways to prepare the Tajine. In the original qidra style, "Saman" (clarified butter) is used to lubricate the surface and a puree of chopped onion is added for flavour. For "Muqawlli" style cooking, the ingredients are placed in olive oil to enrich the flavours. The spices Cayenne Pepper, Black Pepper, Paprika, Ginger, Turmeric, Cinnamon are mixed together as a spice mix and are used in marination and to make the puree.



CHAPTER 08 Roasting of Spices

Roasting has been traditionally used as a means to enhance the flavour experience for a long time.

Roasting is a cooking method by which heat is applied to dry foodstuffs with or without oil to enhance the sensorial experience. This heating process changes the flavour, as there is a release of volatile aromatics. These aromatics can then break down and recombine to form new complex compounds by reactions such as Maillard reaction, adding a differentiation to the product profile. It also drives off excess moisture and makes the seeds and spices crispier which make them easy to grind.

Benefits of Roasting

Improves sensory profile

Roasting of spices affects flavour quality (Behera et al., 2004). The main purpose of roasting is to improve the desirable flavour (Mustafa et al., 2012). Roasting is one of the important phases in the cooking process to release characteristic flavour volatiles (Susheela, 2000) and undesirable constituents. This mild heat treatment gives a better flavour, probably because more odour notes become volatile and easily perceptible (Susan et al., 1996).

Reduction in microbial load

Heat treatment results in reducing the initial load of microorganisms. Reduction is function of temperature and time of roasting.

Ease in Grinding

Roasting results in reducing the moisture, make the spices crunchier and crispier which makes them easier to grind.

Methods of Roasting

There are two main methods to roast spices.

Dry Roasting

In this method, spices are roasted by dry heat. Dry roasting can be achieved by conventional hot air roasting or microwave roasting. Various studies show the differences in sensory profile of spices roasted by the two methods. Conventional roasted samples of Black Cumin show higher concentration of roasted markers pyrazines, furfurals and 3-methylbutanal as compared to microwave roasted samples. (Mustafa Kiralan, 2012). The sensory score of the air oven heated samples of Black Pepper were better than microwave heated samples (Susan Chacko et al., 1996). Microwave roasting showed better retention of characteristic flavour compounds in Cumin (Sushmita Behera et al, 2004).

Oil Roasting

Spice is roasted with little amount of oil. Oil covers the spice and thus results in uniform heating. It also absorbs the lipophilic aromatic compounds from the spices while roasting.

Transformation during the roasting process

Roasting results in the following physio-chemical changes:

Physical changes

- Release of entrapped flavour: Flavours intact in whole spice are released within the spice due to heat, which are otherwise entrapped and thus intensify flavours.
- Uniform distribution of flavours: In a whole spice, the chemical components that provide the flavours vary in concentration throughout the spice. e.g. in Chilli, the greatest concentrations of pungent compounds are found in the inner portions, such as the veins and seeds. Roasting results in distribution of flavours within the spice.
- Change in colour: Usually colour of deep roasted spices gets darker because of the Maillard reaction.

Chemical changes

Roasting changes the spices' chemical compounds and their proportions to varying degrees, giving rise to different flavour profiles. Differences were reported in GC profiles of roasted sample vs non-roasted samples. The chemical reactions that result in transformed flavour profile of roasted spices are mainly Maillard reaction, Strecker degradation and Lipid oxidation.

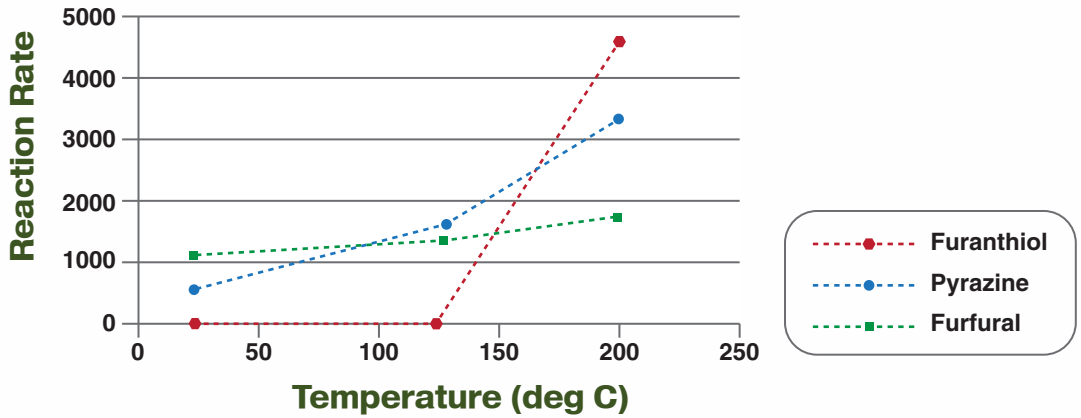
- Generation of Roasting Markers Compounds like Pyrazines, Furans, and Furfurals are produced by Maillard reaction and has been found in roasted spices as given. Pyrazines, Furans and Pyrrole were present only in roasted Black Cumin samples (correlated with sensory attributes) and their concentrations generally increased with roasting time (Mustafa, 2012). Enhanced earthy and fatty notes were perceived in the roasted samples which, could be generated by Maillard reaction and Lipid oxidation respectively.

Volatile compound	Precursors	Reaction mechanism	Examples	Literature reference
Pyrazines	Amino acids and sugar	Maillard Reaction	Methyl pyrazine and 2, 5-dimethylpyrazine	Found in roasted Black Cumin seeds (Mustafa, 2012).
Furans	Amino acids and sugar	Maillard and Strecker degradation mechanisms	2-acetylfuran, and 5-methyl-2-furancarboxaldehyde	Higher level of 5-methyl-2-furancarboxaldehyde formed in conventionally Black Cumin seeds as compared to microwave roasted (Mustafa, 2012).
Furfurals	Amino acids and sugar	Maillard Reaction		Higher level of furfural formed in conventionally Black Cumin seeds as compared to microwave roasted (Mustafa, 2012).
Aliphatic ketone			2, 3-pentanedione	Only detected ketone in conventionally roasted Black Cumin samples and not in raw sample (Mustafa, 2012).
Aliphatic aldehyde	Amino acid	Strecker degradation	3-methylbutanal (derived from leucine), Hexanal (derived from w-6 unsaturated fatty acids)	3-methylbutanal increased significantly upon roasting of Black Cumin. Hexanal was found only in roasted Black Cumin seeds (Mustafa, 2012).

- Changes in concentration of characteristic compounds - The characteristic compounds present in raw samples reduces upon roasting. Terpenes, the characteristic volatile compounds of raw Black Cumin, decreased in roasted samples (Mustafa Kiralan, 2012). Heating of Black Pepper resulted in changes in relative composition of major components like limonene, pinenes, sabinene, and caryophyllene. etc., which may be responsible for the change in flavour profile after heating. No major constituents were completely lost during the heating regime (Susan Chacko et al., 1996).

Volatile compound	Examples	Literature reference
Terpenes	α-pinene, β-myrcene, α-phellandrene, α-terpinene, carvacrol	Concentrations generally decrease when roasting time was increased (Sushmita, 2004).

The flavour profile of roasted spice is dependent on the roasting temperature and time. At T°C < 100°C, spice roasting is a mild heat treatment, rendering lesser aroma compounds formation in roasty, toasty, nutty and burnt directions. The reaction rate is increased at temperatures above 100°C and thus results in significant flavour differentiation. Particular pathway of flavour formation has its own activation energy. As illustrated in the plot below, furanthiol has the highest activation energy, followed by pyrazine and furfural. The high activation energies indicate a very strong temperature dependence of pyrazine formation and explain why most pyrazines (roasted, nutty, toasted notes) are formed during high temperature treatment.



Source: Changes in food flavour due to processing, In: Flavour Chemistry and Technology, Reineccius, 2006

Impact of Roasting on Sensory Properties

Raw and roasted spices exhibit different flavour profile due to generation of new compounds during roasting. Spice roasting creates a balanced flavour character of roasted masala with stronger roasted aroma and greater impact in terms of spice characteristics. On the other hand, green note diminishes. Pyrazines, the roasting markers are correlated with sensory attributes, such as nutty, roasty, greenish, cocoa, roasted nuts, woody, and potato chips (Siegmund and Murkovic 2004). Furans, another roasting marker possesses a pleasant and sweet flavour note (Shahidi, 1997). Minute quantity of their products can sufficiently differentiate roasted from non-roasted masala. Sensorially, the pungent pepper odour was heightened moderately by roasting Black Pepper (Susan Chacko et al., 1996) as compounds like piperine, nonvolatile at room temperature, becomes volatile.

Communication on Roasting

There are many products in market communicating the goodness of roasting. In some products, communication emphasized on roasting method e.g. “Slowly roasted Cumin”, “Deeply roasted Black Pepper”, “Slowly roasted spices” to give essence of home like cooking to consumers.

Nestlé Products with ROASTED SPICES

Competitor Products with ROASTED Communications

Garlic and Thyme Tomato Sauce, UK

Communication on Pack "contains oak roasted tomato"

Buckwheat Noodles, Japan

Communication on Pack "contains roasted curry powder and separate sachet of 7 roasted Spices"

Shanik Sweet Potato Cauliflower Curry, USA

Communication on Pack "contains roasted cumin, cilantro and fennel"

S&B Golden Curry Very Spicy Curry, Japan

Communication on Pack "contains roasted 35 Spices"

Recipe Mix Five Spices Stew, Thailand

Communication on Pack "contains roasted spices including cinnamon and star anise"

Chow Mein Udon Noodles, Japan

Communication on Pack "contains roasted curry flavoured Spices"

R&D Activities

Project Orchestra, a Cat1 knowledge building project has been initiated by NPTC Food to build competency on roasting technologies. The project aims to explore and develop spice transformation technologies using heat and other "kitchen type" tools to create winning and differentiating sensory properties in our products.

Mastering the roasting process will be key to achieve the goal of creating winning differentiating taste. The target would be to use roasted culinary ingredients to reduce the utilization of flavours from suppliers, while ensuring winning taste and aroma and in consequence to eliminate the labelling of flavours for better consumer communication.

A consumer research on roasting perception was completed in key markets across zones and results are shared in Consumer Insights chapter.

CHAPTER 09

Quality and Food Safety

Spice Quality

The right quality is essential so that spices can meet specification standards of international trade and especially for usage in our products. Quality concerns generally revolve around cleanliness, safety or economic elements. One can broadly classify the general quality parameters under three categories namely physical, chemical and microbiological.

Foreign Matter

This includes all the matter that is foreign to the plant which consists of toxic matter, stones, wood, glass, metals etc.

Extraneous Matter

This includes all the matter from the specific plant other than the desired part which could consist of leaves, twigs, husks, stem etc.

Microbiology

Microbiological spoilage of spices by certain species and pathogens can pose as a severe health hazard. Various methods have been listed by ASTA, to detect the various microorganisms in spices and ensure that they exist within permissible limits. Pathogens like salmonella spp are specifically to be absent from spices. Other pathogens associated with spices include *Bacillus cereus*, Enterobacteriae, yeast and moulds

Moisture Content

Measure of moisture in the spice is important as it determines the weight, which in turn determines the price. Additionally, moisture levels also impact the flavour profile.

Total Ash

This is a measure of the level of impurities in a product, obtained by burning off the organic matter and measuring the residue of ash.

Active Ingredient

Each spice contains an important property that it is attributed to and an active ingredient that allows it to be characterized that way.

Water Activity

Water activity determines the extent of microbial spoilage of the spice. High water activity promotes spoilage.

Acid Insoluble Ash

This a measure of the cleanliness of the spice. Acid insoluble ash is also a reliable indicator of the sand or grit content in the spice.

Volatile Oil

Volatile oil helps to identify if the spice has been adulterated or not by the addition of foreign material, spent amounts of spice etc.

Food Safety

Spices have a long fragmented supply chain, from farmer to our factories, so to ensure the integrity, hygiene and quality of spice is complex. Understanding this complexity is of utmost importance to ensure appropriate controls and mitigation measures to detect or prevent the vulnerabilities.

The food safety of spices can be broadly classified into contamination and adulteration or food fraud.

Contamination

Contamination can be defined as the presence of unwanted yet minor contaminants in a substance which leads to deterioration in the quality. This can be due to various physical, chemical or microbial factors.

Adulteration

Adulteration is the deliberate and intentional inclusion of substances in spices whose presence is not legally declared, is not permitted or is present in a form which might mislead or confuse the consumer, leading to an imitated food and/or a product of reduced value, as well as the deliberate and intentional removal of any valuable constituent from a spice.

Contamination

Contamination in spices can be classified into physical, chemical and microbial.

Physical

Spices being an agricultural produce, are prone to physical contamination. The ASTA cleanliness specifications list extraneous/foreign matter that is considered to be a physical hazard. The list includes, but is not limited to; stones, dirt, wire, string, stems, sticks, nontoxic foreign seeds, excreta, manure and other animal contamination.

Chemical

A wide range of chemical contamination may occur in the production of spices and during post-harvest operations. Some ingredient-related chemical hazards are natural components of food, such as food allergens, or are produced in the natural environment, such as mycotoxins, whereas other ingredient-related hazards (e.g., pesticides, drug residues, heavy metals, environmental contaminants) are contaminants of raw materials and other ingredients.

Mycotoxins: These are toxins that originate from toxigenic fungi and subsequently result in mycotoxins such as Aflatoxin or Ochratoxin. The aflatoxins (B1, B2, G1 and G2) are a group of structurally related toxic metabolites produced by at least four species of Aspergillus, *A. flavus, A. parasiticus, A. nominus* and *A. niger*. Ochratoxin A (OTA) is another most frequently occurring group of structurally related toxic compounds. OTA is typically produced by the mold species *Aspergillus ochraceous* and *Penicillium verrucosum*. Low levels of mycotoxins, when found, are most commonly present in Capsicums, Turmeric, Ginger, Nutmeg, Mace and White & Black Pepper.

Pesticides: The advent of commercial spice cultivation results in the usage of chemicals for pest control, which often leads to residues in the spices. The term pesticide is used for products such as insecticides, fungicides, rodenticides, insect repellents, herbicides or weed killers, and some antimicrobials that are designed to prevent, destroy, repel, or reduce all types of pests. Default Maximum Residue Limits (MRLs) are defined for agricultural commodities by individual countries or regions.

NOTS: Spices may contain Naturally Occurring Toxic Substances (NOTS) like Coumarin, Safrole, Myristicin etc. Coumarin (2H-1-benzopyran-2-one) is found in spice Cassia *(Cinnamomum cassia)* sometimes sold as Cinnamon. Safrole (1-allyl-3, 4-methylenedioxybenzene) is found in essential oils of Nutmeg (*Myristica fragrans*), Cinnamon (*Cinnamomum verum*). Myristicin (6-Allyl-4-methoxy-1, 3-benzodioxole is a naturally occurring insecticide and acaracide that is found in Nutmeg and Mace (*Myristica* spp.) at concentrations of 1.3% and 2.7%, respectively. It is also present in Black Pepper.

Heavy Metals: Heavy metals, including lead, cadmium, arsenic, and mercury, may be of concern in spices as a result of agricultural practices. The heavy metal presence may be due to the use of pesticides containing heavy metals or soil containing elevated levels of heavy metals due to industrial waste.

Illegal Dyes: The presence of illegal dyes may be incidental or deliberate. Majority are oil soluble, aromatic compounds containing azo group (-N=N-). Some common illegal dyes detected in spices are Sudan I-IV, Parared and Rhodamine B among others. The incidental contamination of dye residue in spice occur in the range of 10 to 100ppb. These may be due to coloured pesticides and insecticides or arising from material handling such as from inks used for the inscription of sacks, usage of red bags for drying, transport and storage.

Allergen: A possible cross contamination with allergens, at the production or processing may pose a chemical hazard in spices. Certain spices have now been classified as having potential allergenic properties. At present the list of spices that come into this category are Mustard, Celery and Sesame seed. In some countries Coriander is considered as an allergen. The presence of sulphur dioxide may lead to allergic reactions. Traditionally sulphur has been used within the spice industry, either to improve the visual appearance of spices or as a pest prevention method.

Microbial

Spices may harbour numerous bacteria and fungi due to the environment in which they are grown. These microbes may include potential spoilage organisms and occasionally organisms of public health significance. In general, roots, berries, and herbs carry a greater microbial load than bark and seed products. Although a number of microorganisms are killed during the drying of spices and herbs, many bacteria and molds survive. The improper storage and handling of spices and/or poor personal hygiene among food handlers and production workers also results in high microbial load. The bacterial and fungal species in spices include aerobic spoilage organisms, spore forming bacteria, high heat stable toxin producing bacteria, proteolytic and gas-producing bacteria, and mycotoxin-producing microorganisms. Of all the spices, Black Pepper typically has the highest aerobic plate counts, usually in excess of 10^6 cfu/g. Paprika, Celery, Coriander, Turmeric, Thyme, Basil and other spices can also have plate counts in the millions per gram.

Adulteration

Most adulterations in spices are economically motivated. The addition of adulterants to food to increase attractiveness and value is often referred to as economically motivated adulteration. The economically motivated adulteration of spices can have serious implications. In some instances, spices have been adulterated with highly toxic materials such as lead-bearing pigments and other unapproved colour additives. In these instances, adulteration may have serious public health consequences. There have also been instances when the bulking material added was an allergen and when unlabelled, poses a serious public health threat to individuals with food allergies.

Adulteration Type	How		Example
Substitution	With species other than declared		Black Pepper berries substituted with papaya seeds
Dilution	Increase volume or weight by addition of	Extraneous matter	Powdered stem added to Chilli powder
		Foreign matter	Talc, saw dust or starch added to spice powder
		Exhausted material	Exhausted Cumin added to Cumin powder
Mislabelling	On authenticity, origin label, organic vs non-organic		Wrong claim on authenticity
Concealment	Hide inferior quality by	Addition of flavours	Usage of oleoresin undeclared, synthetic spice flavours (e.g. Turmerone inTurmeric)
		Addition of dyes	Sudan dyes in Chilli Powder
		Coating with mineral oil	Mineral oil coated on Black Pepper berries

Food Fraud Prevention Toolkit

A Nestlé Food Fraud Prevention Toolkit for Spices has been published in 2017, as a result of the vulnerability and analytical gap assessment work from NRC, CO-QM and Ingredient Advisor. The adulteration risks have been characterized for spices and sets of analytical control criteria defined based on which a surveillance plan should be established at market level. The surveillance plan allows to build confidence in our suppliers, gain reassurance on our raw material supply and confirm that our prevention measures are adequate, or in contrast to detect food fraud issues. A number of spice specific control measures can be incorporated both in i) Surveillance plans and ii) Audit routines which are listed in this toolkit.

CHAPTER 10 NHW

Landscape

Spices have a traditional history of use, with strong roles in cultural heritage, and in the appreciation of food and its links to health.

Food is eaten in combinations, in relatively large, unmeasured quantities under highly socialized conditions. The real challenge lies not in proving whether foods, such as spices, have health benefits, but in defining what these benefits are and developing the methods to expose them by scientific means.

The benefits of spices can be mapped in various ways, as their usage has been historic and interwoven with cultural and sometimes religious sentiments. The actual scientific benefits are also emerging for some bioactive compounds present in spices but they are yet to be accepted along with the food matrix. These benefits hence have been shared under 3 heads:

1. Perception based- coming mainly from the Nestlé conducted Farmer Rainbow study. These benefits capture the feelings of the consumers (wherever they be originating from)
2. Traditional usage- these benefits have been picked from traditional books in Ayurveda and Chinese medicine among others. They have been known for being used culturally and are inscribed in a text format. Their scientific credibility is under scanner and is generally used basis perception.
3. Science based- these are the benefits which have been indicated via modern scientific trials basis- in-vitro, in-vivo (animal) or some in-vivo (human). Some are still nascent/early grade and require deeper scientific research.

Benefits of Spices

Spice	Perception Based	Traditional Usage	Science based
Turmeric	Protection - "protects me/my family from diseases"	In Ayurveda turmeric is used to treat "biliary disorders, anorexia, cough, diabetic wounds, hepatic disorders, rheumatism, and sinusitis.	Anti-cancerous, anti-inflammatory, antibacterial, antifungal, antioxidant, hypoglycemic, antiseptic and wound healer.
Black Pepper	Digestive health and sore throat	Useful in gastrointestinal disorders, chronic malaria, epilepsy, toothache and cough or throat irritation.	Improves digestive health, anti-inflammatory, anti-carcinogenic, antimicrobial properties. Stimulates cell multiplication and function.
Red Chilli	Weight loss and increases the metabolic rate	Stimulates good digestion, pain killer for arthritis, headaches, burns and neuralgia. Boosts immune system and lowers cholesterol. Useful in treating depression and diseases of gastro-intestinal tracts.	Useful in improving weight loss and treating pain and other neurological conditions. Used in hypoglycemia.
Cumin	Digestive health purposes	Stimulant, carminative, astringent, eupeptic, antispasmodic, and used in the treatment of mild digestive disorders, diarrohea, dyspepsia, flatulence, morning sickness, colic, dyspeptic headache and bloating, promote the assimilation of other herbs and to improve liver function.	Antidiabetic, antibacterial, antifungal, antioxidant, anti carcinogenic, anti mutagenic, Immunomodulatory, estrogenic/anti-osteoporotic, provides gastrointestinal support, antiglycative, prevents memory loss, anti-inflammatory, useful in irritable bowel syndrome.
Coriander Seed	Overall healthfulness	Used as carminative and is helpful in indigestion and other bowel complaints. Roasted seeds are helpful in Dyspepsia.	Digestive health properties, antihelmentic, antibacterial, antioxidant, diuretic and antidiabetic.

The medicinal properties and health benefits of spices are well known since long time and have been used traditionally in treating several disorders as reflected in table. Many scientific studies are conducted to learn more about the antiseptic, anti-inflammatory, anti-bacterial, anti-carcinogenic properties, reduce blood sugar levels, etc.

The health and wellness attribute of spices can be ascribed to the various bioactive phytochemicals they contain. A few of the important spices are reviewed in this chapter.

Turmeric

Known as the "Golden Spice", Turmeric (*Curcuma longa*) has been vastly used in various foods especially in the Indian cuisines, and curries. The bio-active compound of turmeric is 'curcuminoids' and the three main curcuminoids are: curcumin, bis-demethoxycurcumin and de-methoxycurcumin. Curcuminoids have been widely accepted to be containing healing properties and is known to work against many critical diseases. Curcumin may not be as beneficial as turmeric in its entirety due to variation in bioavailability. This extrapolation should be taken into consideration when attempting to reap the benefits of turmeric.

Black Pepper

Known as the "King of Spices", Black Pepper (*Piper nigrum* L) vine and its extracts have been used as a folk medicine in a variety of cultures worldwide. Black Pepper constituents include fiber, essential oils, piperine, eugenol, the enzyme lipase, and minerals. Essential oil components include α- and β pinene, limonene, and β-caryophyllene, 2,4 Piperine and its isomers are the major factors responsible for the pungency and irritant action of Black Pepper. The chemical piperine, 1-piperoylpiperidine, is the major bioactive component present in both Black and White Peppers and individually has numerous reported physiological and drug-like actions similar to those reported for Black Pepper. Piperine is said to act as thermogenic compound enhancing the thermogenesis of lipid and accelerate energy metabolism. It is also believed to increase the serotonin and beta-endorphin production in the brain.

Red Chilli Pepper

Red Peppers are part of a group of 20 plant species belonging to the genus Capsicum of the botanical family Solanaceae. Principal species used in foods are *Capsicum annuum* L and *Capsicum frutescens* L. Red Pepper actually encompasses a variety of plants with diverse common names that include Chilli Pepper, Tabasco Pepper, African Chillies, Paprika, and Cayenne Pepper. Capsaicin is the ingredient of Red Pepper that imparts the "hot" sensation to the tongue and also imparts its health benefits. Capsaicin can activate the transient receptor potential ion channel of the vanilloid type (TRPV1) and has led to the use of Red Pepper extracts, capsaicin, and its analogs in pharmacological strategies for treating pain and other neurological conditions.

Cumin

Cumin (*Cuminum cyminum*) is a flowering plant in the family Apiaceae. Cumin seed is commonly used as a condiment and flavouring in many eastern dishes. Cumin is known for its antioxidant properties. The most important chemical component of cumin fruits is the essential oil content, ranging from 2.5% to 4.5% which is pale to colourless depending on age and regional variations. Cumin essential oil contains cuminaldehyde (4-isopropylbenzaldehyde), pyrazines, 2-methoxy-3-sec-butylpyrazine, 2-ethoxy-3-isopropylpyrazine, and 2-methoxy-3-methylpyrazine.

Coriander

Coriander (*Coriandrum sativum*) is a small, hollow-stemmed plant in the Apiaceae family. Pleasant, aromatic and spicy, its seeds have found utility since ancient times in cooking as well as in various traditional medicines. The unique aromatic flavour of coriander seeds comes from their essential volatile oils and fatty acids. Some important fatty acids in the dried seeds include petroselinic acid, linoleic acid (omega 6), oleic acid, and palmitic acid. Also, the seeds contain essential oils such as linalool (68%), a-pinene (10%), geraniol, camphene and terpene.

Cinnamon

Cinnamon (*Cinnamomum verum*) has been proven to have an immense health benefit. Lately, Cinnamon has also shown to aid weight loss and anti-obesity effects. This has been linked to its major active component cinnamaldehyde. Ingestion of cinnamaldehyde has shown significant increase in energy expenditure and enhanced postprandial fat oxidation. Classified as a TRPA1 agonist, cinnamaldehyde stimulates thermogenesis and sympathetic nervous system (SNS) causing an increase in energy metabolism by sensory nerve stimulation. Further, cinnamaldehyde has also shown potential to inhibit L-type calcium channel and induce vasodilatation. In two groundbreaking studies, scientists from the Nestlé Research Center (NRC) and from the Laboratory of Neural Microcircuitry (Brain Mind Institute, EPFL Dept/School of Life Sciences) show that some active ingredients in spices such as Cinnamon and Mint could fight against conditions like obesity, diabetes, and even epilepsy. The two studies are published in Scientific Reports. The studies reported that cinnamaldehyde (a Cinnamon extract) and capsaicin (a Chilli Pepper extract) worked effectively in raising energy expenditure and fat oxidation levels and Cinnamon extract could potentially be used in foods to help prevent weight gain.

As of today, the available literature reviews shows the health and wellness attributes of spices are due to the various bioactive phytochemicals. However, it is evident that not all species (especially of Turmeric and Red Chilli) are investigated. This presents an opportunity to discover interesting plant secondary metabolites.Also there are opportunities to investigate poorly known species and to develop breeding programs with potential targets: bioactive content, production yield or sensory attributes.

CHAPTER 11 Claim Guidance

A "claim" is any voluntary representation (e.g. text, sound, visual elements) which states, suggests or implies that a product has particular characteristics relating to its origin, nutritional properties, nature, production, processing, composition or any other quality. This definition includes nutrition and health claims as well as social and environmental claims.

Our ambition is to be the recognized leader in Nutrition, Health and Wellness by enhancing the quality of life with good food and beverages everywhere. Claims provide an opportunity to delight consumers and represent a promise of quality and trust.

Nestlé is committed to providing accurate and responsible consumer communication which empowers consumers to exercise their right to make informed choices and promotes healthier diets and lifestyles.

Meeting consumer expectations and not undermining trust is at the center of what we do. Nestlé claims may be expressed with words or visuals, and must be designed, produced and verified for compliance with this standard and local regulation. Exercising good judgement by assessing claims validity, managing risk and ultimately making sound and informed decisions will position Nestlé as the trusted leader in NHW.

This is an integral part of our Nestlé Corporate Business Principles and is further described in the Nestlé Consumer Communication Principles. The Nestlé Claims Policy complements these Principles and must be implemented in conjunction with them. With this Claims Policy, Nestlé has established a framework for all claims including nutrition and health claims used in consumer communication – across businesses and countries. It has been stressed that all claims must be compliant with local regulations or, where no local regulation exists, with international standards such as Codex Alimentarius and with Nestlé governance rules and procedures.

NB: All claims to be verified and approved by the local regulatory, legal & NHW teams before use in any communication format.

Types of Claims for Spices

In 2013, B-Food launched 'Kitchen Cupboard'. It represents a fundamental transformation of our brands with a strong ambition to put 'more food into food'. Its objective is to craft products only with ingredients consumers can recognize (know and love), while removing or renaming the ones they reject.

On visual representation B-Food recommends to have more than 5% of an ingredient to make a claim or feature a visual representation of the ingredient. However, spices are exempted since it has a significant impact on taste, flavour or visual appearance and are important components in the composition of our products, often used at lower concentration. It is generally acceptable to represent them through true-to-life pictures or words even if they do not reach the 5% threshold. With reference to the position paper on Claims (date: 25.10.2017) from B-Food, below are the summary points.

Ingredient Claims

Content Claims	Comparative Claims Increase	Absence/Non-Addition Claim
Contains/ made with fresh Coriander	More (than) Pepper/ as much as Pepper	No artificial flavouring

Nutrition Claims

Content Claims	Comparative Claims Increase /Reduction	Absence/Non-Addition Claim
High in antioxidants	More fibre	No added salt

*Strategic Principles: Absence, Non-Addition and Reduction Claims may be used only when necessary. They must always be embedded in a positive context for consumer reassurance.

Other Claims

Nature, Production or Processing	Absence for Diatetic Needs	Claiming Novelty
Organic	Gluten free Lactose free	New
Natural		New recipe
Vegetarian		First time ever used
Halal		

Strategic Frame and Principles for Successful Claim Development

The Nestlé Claims Standard and Policy and the spirit of the claim strategy are to be fully integrated into the product and communication strategy, and it is to be ensured that all relevant actions are in place. Nestlé ambition is to make presence claims - to offer consumers products that are clean by design and that embrace 'Kitchen Cupboard' to achieve positive claims. The latest B-Food documents are published on the Simply Good site.

Key strategic questions checklist for claim strategy

Rationale?	Approved?	Communication Strategy?
Does the claim make sense?	Can we use the claim?	How to use the claim?
Know your Consumers, Brand and Category	**Build Category Claims Strategy**	**Develop Communication**
✓ Consumer insights	✓ Confirms to Nestlé policy and standard	✓ Key product truth determines the positive message
✓ Brand fit	✓ Regulatory compliant	✓ Positive and reassurance messaging
✓ Business impact	✓ Impact on other Nestlé categories?	✓ Impactful & scalable
✓ Scientific validation		

CHAPTER 12

Regulatory Landscape

From a regulatory perspective, spices are primarily governed by horizontal standards, e.g. standards on chemical contaminants, microbiology, labelling and claims etc.

Horizontal standards ensure that food regulations cover the entire food supply chain - from primary production to consumption. The objective of reduced risk can be achieved most effectively by the principle of prevention throughout the production, processing and marketing chain. This calls for a comprehensive and integrated farm-to-fork approach in which the producer, trader, processor, international traders, vendors and consumer all play a vital role in ensuring food safety and quality.

Therefore, whenever food standards are to be revised, the approach should be to develop horizontal standards. However, commodity standards may be developed only when, horizontal standards alone are not deemed sufficient - to protect public health and safety, to provide consumers with adequate information to ensure informed choices, to prevent fraud and deception, to promote fair trading in food, to promote trade and commerce in food, and to promote consistency between domestic and international food standards.

The Codex Alimentarius Commission (CAC) is a subsidiary body of the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) and has become the global reference point for consumers, food producers and processors, national food control agencies and the international food trade. The principle role of the CAC is to develop food standards that can be recommended to governments for adoption. The Codex standards and related texts are voluntary in nature and need to be translated into national legislation or regulations in order to be enforceable.

Agreement on the Application of Sanitary and Phytosanitary Measure (SPS) and the Agreement on Technical Barriers to Trade (TBT) under World Trade Organization (WTO) both acknowledge the importance of harmonizing standards internationally so as to minimize or eliminate the risk of sanitary, phytosanitary and other technical standards becoming barriers to trade. In its pursuance of harmonization, with regard to food safety, SPS Agreement has specifically identified the standards, guidelines and recommendations established by the Codex Alimentarius Commission. This means that Codex standards are considered scientifically justified and are accepted as the benchmarks against which national measures and regulations are evaluated. The specific recognition by WTO of Codex standards has stimulated considerable interest in the activities of the Commission. Within codex, there are committees dealing with both horizontal and with vertical subjects. In 2013, Codex Committee on Spices and Culinary Herbs (CCSCH) was established, whose role is to elaborate worldwide standards for spices and culinary herbs.

Codex Alimentarius Commission

Executive Committee | **Secretariat**

General Committee	Commodity Committees and Task Forces	Regional Committees
e.g. Labelling, Contaminants in Food, Food Additives, Pesticide Residues, Food Hygiene, etc.	e.g. Cereals, Pulses and Legumes; Processed Fruits and Vegetables; Spices and Culinary Herbs etc.	Africa, Asia, Europe, Latin American and the Caribbean, North America and South West Pacific, Near East

Spice Notes in Documentum

Questions like “is this allowed”, “how do I label it”, “can I combine this along with other spices”, “is approval required” etc. have been addressed in Notes on Spice Regulations which is published in Nestlé Documentum and link is also available on intranet at Nest Spice Page.

The essence of the notes is as below.

Spice Standards

In the absence of Codex Standards on spices, other organizations have established specifications on certain spices, which may voluntarily be used as reference points for international trade, if agreed by both parties. ISO is one of the most important standard setting bodies in that regard. Other than that, the European Spice Association and the International Organisation for Spice Trade Associations have elaborated standards covering minimum quality and hygiene parameters. In those voluntary standards, there is broad consensus that spices should be whole (including ground/powdered), i.e. no volatile oil or other component removed from them. Different regulatory bodies have specified certain physico-chemical characteristic limits e.g. moisture, total ash, acid insoluble ash and minimum volatile oil content, as quality parameters for individual spices. Further, parameters that need to be analyzed for the import of spices, have also been specified by some countries.

Spice Extracts Regulations

Addition of the extracts of spices to food may be a way to reduce the reliance on flavour boosting additives and enhancing the natural spice and flavour delivery. Regulations are divided in the classification and labelling of such extracts with some treating the same as ingredients and others as flavours. The quantity of the extract added and manufacturing process seems to weigh on the interpretation. While herbs and spices are categorized as food ingredients with flavouring properties by the CODEX, their extracts fall within the definition of “natural flavouring complexes”. As per CODEX and USFDA, < 2%, they can be clubbed along with spices and labeled ‘Spice’ in the ingredient list. They can also be labeled “Natural xxx flavour” or “xxx extract” in most countries. In many countries, evaluation and approval are not required for natural flavouring complexes (spice extracts) and food ingredients with flavouring properties (spices).

Enzymatically Hydrolyzed Spices

Enzymatic hydrolyzis of spices may be another way to boost the spice flavour delivery though literature on this is scant. Enzymes are additives and/or processing aids, depending on their intended use. As a general rule labelling regulations require the listing of enzymes in the ingredient list if used as ingredients, but labelling is not required if used as processing aids and either removed after processing or irreversibly denatured during the manufacturing process. Some jurisdictions have elaborated lists of permitted microorganisms and their enzymes, and conditions of use. However, in many cases, the use of processing aids is primarily governed by general food safety and hygiene principles, along with the general principle of not misleading the consumer, i.e. there is often no defined regulatory frame with regard to which processing aids may be used during the production of food. While labelling the enzymes as such may not be required, if used as processing aids, labelling the process of hydrolyzation (i.e. “hydrolyzed [name of the spice]”) may be required, if omission of the term “hydrolyzed” has the potential to mislead the consumer. This will have to be considered on a case by case basis.

CHAPTER 13 Spice Organisations

Many spice organisations exist that represent national and global concerns in order to make a positive impact on the spice industry.

There is a growing consciousness about the quality and purity of spices coupled with concerns over government policies and regulations as well as harmonising standards for the spices. A few significant spice organisations are described in this chapter. These organisations connect a diverse range of stakeholders from across the globe, including international bodies such as the United Nations Conference on Trade and Development, the World Trade Organization and the United Nations Food and Agriculture Organization and many of the organisations work through collaboration with extensive networks of farmers, scientists, processors, government, international trade bodies and other not-for-profit organisations and ensure safe and sustainable production of spices.

European Spice Association

The European Spice Association (ESA) is the umbrella organisation of the European spice industry that represents the interests of its members in all matters pertaining to the processing, packing, quality assurance and food safety and/or marketing of herbs, spices and spice products like seasonings. It represent the interests of its members vis-à-vis the competent bodies and departments of the European Union, as well as international institutions and organisations. ESA has come out with the 'Quality minima for herbs and spices'. This serves as guideline specifications for member countries in the European Union and it is the leading document for the most important European buyers as it provides an overview of legal requirements and non-legal (e.g. quality, food safety, labelling) requirements.

American Spice Trade Association

The American Spice Trade Association (ASTA) plays an important role in the cleanliness specifications of spices. This organisation works to ensure the supply of clean, safe spice, shape public policy on behalf of the global industry and advance the business interests of its members. It represents US industry interests and is involved in regulating the quality of spices entering the USA. ASTA's members include U.S.-based importers and companies based outside of the U.S. that grow spices and ship them to the U.S. The ASTA members manufacture and market the majority of spices sold in the U.S. for industrial, food service and consumer use.

International Organization of Spice Trade Associations

The International Organization of Spice Trade Associations (IOSTA) was established in 2000 and was designed as a common platform for the betterment of World Spice Industry that represents the interests of the international spice trade before international bodies. Members include the American Spice Trade Association, Canadian Spice Association, European Spice Association (representing its members comprised of various country associations), All India Spice Exporters Forum, and the All Nippon Spice Association. As an organisation it focusses to address issues as they arise and has participation including the International Pepper Community, the Vietnam Pepper Association, and the World Spice Organization among others. The Mission of IOSTA is stated as: IOSTA brings together spice associations from around the world to address common issues and seek sensible solutions to ensure the sustainability of the spice industry.

International Pepper Community

The International Pepper Community was established in 1972 under the auspices of the United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP) with an aim to promote, co-ordinate and harmonize all activities relating to the pepper economy. The IPC Secretariat is located in Jakarta, Indonesia. The Community includes India, Indonesia, Malaysia, Sri Lanka and Vietnam as permanent members and Papua New Guinea, Philippines as an associate member. The International Pepper Community maintains close contacts with the United Nations Organization and its special agencies to undertake activities and functions that are desirable in the interests of the world pepper economy.

INTERNATIONAL PEPPER COMMUNITY

Spices Board India

The Spices Board is the Indian government regulatory and export promotion agency that spearheads the quality improvement program for Indian spices. Spices Board was constituted in 1987 under the Spices Board Act 1986 and it is one of the five Commodity Boards functioning under the Ministry of Commerce and Industry. The board is head-quartered in Kochi with a state-of-the-art testing laboratory and is responsible for the export promotion of the 52 scheduled spices and development of Cardamom. There are regional laboratories through which the Spices Board makes mandatory quality checks for spices exported from India. The primary function of the Board includes production development promotion, development and regulation of export of spices. The activities of the board include issue of certificate of registration as exporter of spices, undertaking programs and projects for promotion of export of spices like setting up of spices parks, support of infrastructure improvement in spices processing, assisting and encouraging studies and research on medicinal properties of spices, development of new products, improvement of processing, grading and packaging of spices, striving towards stabilization of prices of spices for export and controlling and upgrading quality for export.

स्पाइसेस बोर्ड भारत

References

1. Barzegar A, Moosavi-Movahedi AA, (2011), Intracellular ROS Protection Efficiency and Free. Radical-Scavenging Activity of Curcumin. PLOS ONE 6(10): e26012.
2. Bengmark, S., Mesa, M. D., &. Gil, (2009). A. plant-derived health— the effects of turmeric and curcuminoids. Nutricion Hospitalaria, 24, 273-281.
3. Bryant and W.L. Silver. 2000. Chemesthesis, in The Neurobiology of Taste and Smell (eds T.E Finger, W.L. Silver, and D. Restrepo), New York: Wiley-Liss Inc., pp. 73–100
4. Eldershaw, T.P., Colquhoun, E.Q., Bennett, K.L., Dora, K.A., and Clark, M.G. 1994. Resiniferatoxin and piperine: capsaicin-like stimulators of oxygen uptake in the perfused rat hindlimb. Life Sciences, 55 (5), 389–397.
5. Elisabeth Guichard, Christian Salles, Martine Morzel, Anne-Marie Le Bon, Flavour: From Food to Perception
6. Gary Reineccius, 2005, Flavour Chemistry and Technology, Second Edition, CRC Press
7. Guillou Pascale, and Marjon van Opijnen, 2010, Could you pass me the sustainable pepper, please? Towards a sustainable spices supply chain, Keys findings and sector recommendations, CREM in collaboration with Both ENDS and Cordaid.
8. H. Parker. 1912. The relations of smell, taste and the common chemical sense in vertebrates. J. Acad. Nat. Sci. Phila
9. Hameed, S., Dhillo, W., and Bloom, S. 2009. Gut hormones and appetite control. Oral Diseases, 15 (1), 18–26.
10. Kawada, T., Sakabe, S., Watanabe, T., Yamamoto, M., and Iwai, K. 1988. Some pungent principles of spices cause the adrenal medulla to secrete catecholamine in anesthetized rats. Proceedings of the Society for Experimental Biology and Medicine, 188 (2), 229–233.
11. Kenji Hirasa, Mitsuo Takemasa, 1998, Spice Science and Technology, CRC Press
12. Laura Vay, Chunjing Gu, Peter A McNaughton, The thermo-TRP ion channel family: properties and therapeutic implications, British Journal of Pharmacology 165 (2012): 787–801
13. Mekha, M.S. & Shobha, R.I. & Rajeshwari, C.U. & Andallu, Bondada. (2014). Aging and Arthritis: Oxidative Stress and Antioxidant Effects of Herbs and Spices. Aging: Oxidative Stress and Dietary Antioxidants. Academic Press, London. Chapter 23, pp.233-246.
14. Mustafa Kiralan, 2012, Volatile Compounds of Black Cumin Seeds (Nigella sativa L.) from Microwave-Heating and Conventional Roasting, Journal of Food Science Vol 77 No 4 P 481-483.
15. Okumura, Y., Narukawa, M., Iwasaki, Y., et al. 2010. Activation of TRPV1 and TRPA1 by black pepper components. Bioscience, Biotechnology, and Biochemistry, 74 (5), 1068–1072.
16. Prakash, U.N. and Srinivasan, K. 2010. Beneficial influence of dietary spices on the ultrastructure and fluidity of the intestinal brush border in rats. British Journal of Nutrition, 104 (1), 31–39.
17. Raghavan, S. 2007. Spices, Seasonings, and Flavourings, 2nd edn, Boca Raton, FL: CRC Press.
18. Ravindran, P. N., Nirmal, B. K., & Sivaraman, K. (2007). Turmeric: The genus curcuma. Boca Raton, FL: CRC.
19. Rozin, E. and Rozin, P. 2005. Culinary themes and variations, in The Taste Culture Reader; Experiencing Food and Drink
20. S. Bennis, F. Chami, N. Chami, K. Rhayour, A. Tantaoui-Elaraki, A. Remmal, Eugenol induces damage of bacterial and fungal envelope, Moroccan J. Biol. 1(2004)
21. Shahidi et al., 1997, Effect of processing on flavour precursor amino acids and volatiles of sesame paste, Journal of American Oil Chemical Society, Vol 74 P 667–678.
22. Shane T. McDonald, David A. Bolliet, John E. Hayes, 2016, Chemesthesis: Chemical Touch in Food and Eating, John Wiley & Sons, Ltd
23. Shishodia S., Singh T., Chaturvedi M.M. (2007) Modulation of transcription factors by curcumin. In: Aggarwal B.B., Surh YJ., Shishodia S. (eds) The Molecular Targets and Therapeutic Uses of Curcumin in Health and Disease. Advances in experimental medicine and biology, vol 595. Springer, Boston, MA
24. Siegmund and Murkovic, 2004, Changes in chemical composition of pumpkin seeds during the roasting process for production of pumpkin seed oil, Food Chemistry, Vol 84 P 367–374.
25. SOUZA, Evandro Leite de et al. Antimicrobial effectiveness of spices: an approach for use in food conservation systems. Braz. arch. biol. technol. [online]. 2005, vol.48, n.4 [cited 2017-10- 25], pp.549-558
26. Susan Chacko et al., 1996, Roasting Studies on Black Pepper (Piper nigrum L.), Flavour and Fragnance Journal Vol 11 P305-310.
27. Susheela, 2000, Handbook of spices, seasonings and flavourings Lancaster, Technomic Publishing, P 47-48.
28. Sushmita Behera et al., 2004, Microwave heating and conventional roasting of cumin seeds (Cuminum cyminum L.) and effect on chemical composition of volatiles, Food Chemistry, Vol 87 P25–29.
29. V. A. Parthasarathy, B. Chempakam, T. J. Zachariah, 2008, Chemistry of Spices, CABI; First edition
30. Yoshioka, M., Lim, K., Kikuzato, S., et al. 1995. Effects of red-pepper diet on the energy metabolism in men. Journal of Nutritional Science and Vitaminology, 41 (6), 647–656.

Appendix

SIGNATURE SPICE RECIPES

Chicken and Andouille Jambalaya

Ingredients

- 2 teaspoons cayenne pepper
- ¾ teaspoon paprika
- ½ teaspoon garlic powder
- ½ teaspoon onion powder
- ½ teaspoon freshly ground black pepper
- ½ teaspoon freshly ground white pepper
- ½ teaspoon kosher salt
- ¼ teaspoon ground cumin
- ¼ teaspoon dried oregano
- ¼ teaspoon dried thyme
- ⅛ teaspoon ground coriander
- ⅛ teaspoon ground mustard
- Pinch celery salt

For the jambalaya:

- 2½ pounds boneless, skinless chicken thighs, cut into 2-inch pieces
- ⅓ cup vegetable oil
- 1 tablespoon unsalted butter
- 2 large yellow onions, medium dice
- 12 ounces andouille sausage, medium dice
- 4 ounces tasso or smoked ham, medium dice
- 2 large green bell peppers, cored, seeded, and medium dice
- 3 medium celery stalks, medium dice
- 1 jalapeño, cored, seeded, and finely chopped
- 3 medium garlic cloves, finely chopped
- 1 teaspoon kosher salt, plus more as needed
- 1 (14.5-ounce) can tomato sauce or crushed tomatoes
- 1 tablespoon tomato paste
- 2 cups long-grain white rice
- 3 cups low-sodium chicken stock or broth
- 2 bay leaves
- 2 medium scallions, thinly sliced (white and light green parts only)

Method

- For the spice mix: Place all of the ingredients in a small bowl and stir to combine; set aside.

For the jambalaya:

- Heat the oven to 375°F and arrange a rack in the lower third. Pat the chicken thighs dry with paper towels and set aside.
- Heat the oil in a heavy-bottomed, ovenproof, 7-quart pot or large Dutch oven over medium-high heat until shimmering. Place about one-third of the chicken pieces in the pot and cook, stirring rarely, until browned all over, about 5 to 6 minutes. Remove to a large bowl and brown the remaining chicken in 2 more batches; set aside.
- Remove and discard all but about 1/4 cup of the fat from the pot. Add the butter and melt over medium heat. Add the onions, scrape the bottom of the pot with a wooden spoon to release any browned bits, and cook, stirring occasionally, until the onions just begin to brown, about 6 minutes.
- Add the sausage, ham, and half of the reserved spice mix. Stir to coat everything with the spice mix and cook, scraping the bottom of the pot occasionally, until the meat is browned and the onions are very tender, about 10 minutes.
- Add the bell peppers, celery, jalapeño, garlic, measured salt, and remaining spice mix. Cook, scraping the bottom of the pot occasionally, until the bell peppers have softened, about 10 minutes.
- Add the reserved chicken and any accumulated juices, the tomato sauce or crushed tomatoes, and the tomato paste. Stir to combine and bring to a boil. Add the rice, stock or broth, and bay leaves, stir to combine, and bring to a boil. Cover with a tightfitting lid, transfer to the oven, and bake until the rice is tender and the liquid has been absorbed, about 30 minutes.
- Remove the pot to a wire rack and let it sit, covered, for 5 minutes. Remove and discard the bay leaves. Stir to evenly combine the jambalaya, taste, and season with salt as needed. Sprinkle with the scallions and serve.

Hungarian Goulash

Ingredients

- 600g beef shin or shoulder, or any tender part of the beef cut into 2 x 2 cm cubes
- 2 tablespoons oil or lard
- 2 medium onions, chopped
- 2 cloves of garlic
- 1-2 carrots, diced
- 1 parsnip, diced
- 1-2 celery leaves
- 2 medium tomatoes, peeled and chopped, or 1 tbsp. tomato paste
- 2 fresh green peppers
- 2-3 medium potatoes, sliced
- 1 tablespoon Hungarian paprika powder (sweet)
- 1 teaspoon ground caraway seed
- 1 bay leaf
- Ground black pepper and salt according to taste
- Water

Method

- Heat up the oil or lard in a pot and braise the chopped onions in it until they get a golden brown colour.
- Add the beef cubes and sauté them to a brown colour.
- Sprinkle the braised onions and meat with paprika powder while stirring them to avoid getting the spice burnt.
- The meat will probably let out its own juice, let the beef-cubes simmer in it while adding the grated or crushed and chopped garlic, the ground caraway seeds, some salt ‘n’ ground black pepper, the bay leaf and pour enough water to cover the content of the pan and let it simmer on low heat for a while.
- When the meat is half-cooked (approx. in 1.5 hour) add the diced carrots, parsnip, potatoes and celery leaf and some more salt if necessary.
- When the vegetables and the meat are almost done add the fresh tomato cubes or paste and the sliced green peppers. Let it cook on low heat for another few minutes. Remove the lid of the pan if you want the soup to thicken.

Jerk Chicken

Ingredients

- 3 tablespoons dark rum
- 2 tablespoons water
- ½ cup malt vinegar
- 10 green onions, chopped
- 4 garlic cloves, peeled, chopped
- 2 tablespoons dried thyme
- 2 scotch bonnet chills or habanero chills with seeds, chopped
- 2 tablespoons vegetable oil
- 4 teaspoons ground allspice
- 4 teaspoons ground ginger
- 4 teaspoons ground cinnamon
- 2 teaspoons ground nutmeg
- 2 teaspoons salt
- 2 teaspoons ground black pepper
- 2 teaspoons dark brown sugar
- 1 cup ketchup
- 3 tablespoons soy sauce
- Two 3 - to 3½ - pound chickens, halved lengthwise, rinsed, patted dry
- ½ cup fresh lime juice

Method

- Boil rum and 2 tablespoons water in small saucepan for 3 minutes.
- Transfer rum mixture to blender; add vinegar and next 12 ingredients and blend until almost smooth. Transfer 2 tablespoons jerk seasoning to small bowl; mix in ketchup and soy sauce to make sauce. (Jerk seasoning and sauce can be made 1 day ahead; cover separately and refrigerate.)
- Arrange chicken in large roasting pan or baking dish. Pour lime juice over; turn to coat. Spoon jerk seasoning over chicken and rub in. Cover and refrigerate at least 4 hours, turning occasionally. (Can be prepared 1 day ahead. Keep refrigerated.)
- Preheat oven to 350°F or prepare barbecue (medium heat). Remove chicken from jerk seasoning marinade; sprinkle with salt and pepper. If roasting chicken in oven, arrange chicken, skin side up, on rimmed baking sheet. Roast until chicken is cooked through and juices run clear when thickest part of thigh is pierced with fork, about 50 minutes. If grilling chicken, place chicken, skin side down, on grill rack, cover, and grill until chicken is cooked through, turning occasionally and adjusting heat if browning too quickly, about 50 minutes.
- Cut each chicken half into pieces and serve with sauce.

Pollo a la Brasa (Roasted Chicken) Peruvian-Style grilled chicken with green sauce

Ingredients

- Whole jalapeño chilies, roughly chopped (see note above)
- 1 tablespoon aji amarillo pepper paste (see note above)
- 1 cup fresh cilantro leaves
- 2 medium cloves garlic
- ½ cup mayonnaise
- ¼ cup sour cream
- 2 teaspoons fresh juice from 1 lime
- 1 teaspoon distilled white vinegar
- Kosher salt and freshly ground black pepper
- 2 tablespoons extra virgin olive oil

For the Chicken:

- 1 whole chicken, 3 1/2 to 4 pounds
- 4 teaspoons kosher salt
- 2 tablespoons ground cumin
- 2 tablespoons paprika
- 1 teaspoon freshly ground black pepper
- 3 medium cloves garlic, minced (about 1 tablespoon)
- 2 tablespoons white vinegar
- 2 tablespoons vegetable or canola oil

Method

- For the Chicken: Pat chicken dry with paper towels and place breast-side-down on a large cutting board. Using sharp kitchen shears, remove the backbone by cutting along either side of it. Turn chicken over and lay out flat. Press firmly on breast to flatten the chicken. For added stability, run a metal or wooden skewer horizontally, entering through one thigh, going through both breast halves, and exiting through the other thigh. Tuck wing tips behind back.
- Combine salt, cumin, paprika, pepper, garlic, vinegar, and oil in a small bowl and massage with fingertips until homogenous. Spread mixture evenly over all surfaces of chicken
- Light one chimney full of charcoal. When all the charcoal is lit and covered with gray ash, pour out and spread the coals evenly over half of coal grate. Alternatively, set half the burners of a gas grill to high heat. Set cooking grate in place, cover gill and allow to preheat for 5 minutes. Clean and oil the grilling grate.
- Place chicken skin-side up on cooler side of grill with legs facing towards hotter side. Cover grill with vents on lid open and aligned over the chicken. Open bottom vents of grill. Cook until instant read thermometer inserted into deepest part of breast registers 110°F. Carefully flip chicken and place skin-side-down on hotter side of grill with breasts pointed towards cooler side. Press down firmly with a wide, stiff spatula to ensure good contact between bird and grill grates. Cover and cook until skin is crisp and instant read thermometer inserted into deepest part of breast registers 145 to 150°F, about 10 minutes longer. If chicken threatens to burn before temperature is achieved, carefully slide to cooler side of grill, cover, and continue to cook until done. Do not leave the lid off for longer than it takes to check temperature or chicken will burn.
- For the Sauce: Combine jalapeños, aji amarillo (if using), cilantro, garlic, mayonnaise, sour cream, lime juice, and vinegar in the jar of a blender. Blend on high speed, scraping down as necessary, until smooth. With blender running, slowly drizzle in olive oil. Season to taste with salt and pepper. Sauce will be quite loose at this point but will thicken as it sits. Transfer to a sealed container and refrigerate until ready to use.
- Transfer chicken to a cutting board and allow to rest for 5 to 10 minutes. Carve and serve with sauce.

Shawarma

Ingredients
Marinade

- 1 large garlic clove, minced (or 2 small cloves)
- 8 pcs boneless chicken thighs
- 1 tbsp ground coriander
- 1 tbsp ground cumin
- 1 tbsp ground cardamon
- 1 tsp ground cayenne pepper (reduce to ½ tsp to make it not spicy)
- 2 tsp smoked paprika
- 2 tsp salt
- Black pepper
- 2 tbsp lemon juice
- 3 tbsp olive oil

Yoghurt Sauce

- 1 cup Greek yoghurt
- 1 clove garlic, crushed
- 1 tsp cumin
- Squeeze of lemon juice
- Salt and pepper

To Serve

- 6 flatbreads (Lebanese or pita bread or homemade soft flatbreads)
- Sliced lettuce (cos or iceberg)
- Tomato slices

Method

- Combine the marinade ingredients in a large zip lock bag (or bowl).
- Add the chicken and use your hands to make sure each piece is coated. If using a zip lock bag, it is convenient to close the bag then massage the bag to disperse the rub all over each chicken piece.
- Marinate overnight or up to 24 hours.
- Combine the Yoghurt Sauce ingredients in a bowl and mix. Cover and put in the fridge until required (it will last for 3 days in the fridge).
- Heat grill/BBQ (or large heavy based pan on stove) on medium high. You should not need to oil it because the marinade has oil in it and also thigh fillets have fat. But if you are worried then oil your hot plate/grill.
- Place chicken on the grill and cook the first side for 4 to 5 minutes until nicely charred, then turn and cook the other side for 3 to 4 minutes (the 2nd side takes less time).
- Remove chicken from the grill and cover loosely with foil. Set aside to rest for 5 minutes.

To Serve

- Slice chicken and pile onto platter alongside flatbreads, salad and the yoghurt sauce.
- To make a wrap, get a piece of flatbread and smear with yoghurt sauce. Top with a bit of lettuce and tomato and chicken shawarma. Roll up and enjoy!

Shepherd's Pie

Ingredients

- 1kg potatoes, peeled and diced
- 60ml cream
- 1 tablespoon salted butter
- ½ teaspoon kosher salt
- ¼ teaspoon ground black pepper
- 1 egg yolk,

For the meat filling:

- 1kg pounds ground Lamb
- 3 tablespoons canola oil
- 1 medium-large onion, chopped (about 1¼ cup)
- 2 carrots, peeled and diced
- 2 gloves garlic, minced
- 1 teaspoon kosher salt
- ½ teaspoon ground black pepper
- 2 tablespoons + 1 teaspoon all-purpose flour
- 3 teaspoons tomato paste
- 400ml cups chicken broth
- 2 bay leaves
- 2 teaspoons Worcestershire sauce
- 2 teaspoons fresh rosemary leaves, chopped
- 1 teaspoon fresh thyme leaves, chopped
- 125g cup fresh or frozen peas

Method

- Boil the diced potatoes until tender.
- Drain and return to the saucepan. Add cream, butter, salt and pepper. Mash until smooth.
- Add in beaten egg yolk and stir again until combined. Cover and set aside.
- Brown the lamb mince in a large frying pan. Empty the pan and set aside the meat.
- In the same pan sauté the onion and carrots for 3-4 minutes.
- Stir in the garlic and cook for about 30 seconds.
- Next, add the browned beef, salt and pepper. Combine well and cook for about 3 minutes over a medium heat.
- Sprinkle the meat mixture with flour and toss to coat. Cook for another minute.
- Stir in the tomato paste, chicken broth, rosemary, thyme and bay leaf into the meat mixture. Combine well, cover and simmer for 20-25 minutes, until the sauce slightly thickens. Take out bay leaves.
- Add the peas to the meat mixture, and mix together.
- Transfer beef mixture to a baking dish.
- Spread the mashed potatoes across top, taking care to cover the whole top all the way to the edges. Sprinkle with cheddar cheese.
- Place baking dish bake on the middle rack of 200°C oven for about 25 minutes, or until the potatoes just begin to brown.

Alsatian Choucroute (Sauerkraut)

Ingredients

- 1 pound (450g) boneless pork loin
- 1 pound (450g) boneless pork shoulder
- Kosher salt
- 1/4 cup plus 2 tablespoons (90ml) lard, goose fat, duck fat or vegetable oil
- 2 medium yellow onions, thinly sliced (about 12 ounces; 350g total)
- 2 cups (480ml) dry white wine, such as Riesling or Silvaner
- 1 cup (240ml) homemade chicken stock or low-sodium chicken broth
- 1 cheesecloth sachet containing 2 crushed medium cloves garlic, 10 juniper berries, 2 cloves, 1/2 teaspoon caraway seed, and 2 bay leaves
- 1 pound (450g) slab bacon
- 1 ham hock (about 3/4 pound; 340g)
- 1 (8-ounce; 225g) piece salt pork from the belly or side (not fatback; optional)
- 5 pounds (2.25kg) good-quality store-bought or homemade sauerkraut, drained
- 1 1/2 pounds (680g) mixed French - and/or German-style emulsified sausages, such as frankfurters, bratwurst, weisswurst, boudin blanc, boudin noir, or knackwurst
- 2 smoked pork chops (about 1 1/4 pounds; 560g total)
- 5 small Yukon gold potatoes, peeled, halved, and simmered in salted water until tender
- 2 tablespoons (30ml) kirsch (cherry brandy; optional)

Method

- Season pork loin and shoulder all over with salt. You can either proceed with the rest of the recipe right away, or, if you have time, place both cuts on a wire rack set over a rimmed baking sheet and refrigerate, uncovered, for up to 2 days. (Pre-salting the fresh cuts of pork will season them deeply and help them retain juiciness later.)
- Preheat oven to 250°F (121°C). In a large casserole dish, heat 1/4 cup (60ml) goose fat (or duck fat, lard, or oil) over medium-low heat until shimmering. Add onions and cook, stirring often, until softened but not browned, about 10 minutes.
- Add wine, stock, and cheesecloth sachet to onions. Nestlé pork shoulder, slab bacon, and ham hock in onions and braising liquids and bring to a simmer over medium-high heat. Cut a parchment paper lid sized to fit casserole dish and set directly on top of meats and liquid. Transfer to oven and cook for 1 1/2 hours.
- Meanwhile, Cook Pork Loin: Place pork loin in a small ovenproof skillet or on a rimmed baking sheet and cook on a separate rack in oven until an instant-read thermometer inserted in center registers 120°F (49°C), about 1 hour. Set aside.
- Meanwhile, Prepare Salt Pork (if using): Fill a large saucepan with water, add salt pork, and bring to a gentle simmer. Continue to cook at a very gentle simmer for 1 hour, then transfer salt pork to casserole dish for remainder of cooking time.
- Meanwhile, Prepare Sauerkraut: In a colander, lightly rinse sauerkraut under cold running water, then taste; depending on how much of its sour flavour you want to preserve, you can stop here or continue to rinse until desired flavour is reached. (This will depend on the age and flavour of the sauerkraut and your personal preference.) Using your hands, squeeze sauerkraut dry of excess water.
- After meat in casserole dish have cooked for 1 1/2 hours, add sauerkraut to the casserole dish, mixing it into braising liquids and meats. Raise oven temperature to 300°F (149°C), re-cover with parchment paper lid, and cook until meats are very tender, about 1 hour longer.
- To finish the dish: Fill a large saucepan with water and bring to a bare simmer over medium-high heat. Add sausages, lower heat to maintain a bare simmer, and cook until heated through, about 10 minutes. Keep warm.
- In a skillet, heat remaining 2 tablespoons (30ml) fat or oil over high heat until shimmering. Add reserved pork loin from step 4 and sear, turning often, until well browned all over, about 3 minutes per side. Slice into medallions.
- Remove parchment paper lid from the casserole dish and add pork loin medallions, smoked pork chops, and potatoes. Return to oven and cook until chops and loin are just heated through, 10 to 20 minutes.
- Remove all meats from the casserole dish and set aside on a clean rimmed baking sheet. Discard cheesecloth sachet. Season sauerkraut with salt and stir in kirsch, if using. Using a slotted spoon, heap sauerkraut onto a large warmed serving platter, allowing any excess juices to drain off and arrange potatoes throughout. Drain poached sausages. Arrange meats and sausages all over mound of sauerkraut and serve.

Lamb Tajine

Ingredients

- 1 tsp cayenne pepper
- 2 tsp ground black pepper
- 1½ tbsp paprika
- 1½ tbsp ground ginger
- 1 tbsp turmeric
- 2 tsp ground cinnamon
- 1 x shoulder of lamb, trimmed and cut into 5cm/2in chunks (about 1.1kg/2½lb meat in total)
- 2 large onions, grated
- 2 tbsp olive oil
- 1 tbsp argan oil
- 3 cloves garlic, crushed
- 570ml/1 pint tomato juice
- 2 x 400g tinned chopped tomatoes
- 115g/4oz dried apricots, cut in half
- 55g/2oz dates, cut in half
- 55g/2oz sultanas or raisins
- 85g/3oz flaked almonds
- 1 tsp saffron stamens, soaked in cold water
- 600ml/1 pint lamb stock
- 1 tbsp clear honey
- 2 tbsp coriander, roughly chopped

Method

- Place the cayenne, black pepper, paprika, ginger, turmeric and cinnamon into a small bowl and mix to combine. Place the lamb in a large bowl and toss together with half of the spice mix. Cover and leave overnight in the fridge.
- Preheat the oven to 150 deg C/300 deg F/Gas2.
- Heat 1 tbsp olive oil and 1 tbsp of argan oil in a large casserole dish. Add the grated onion and the remaining spice mix and cook over a gentle heat for 10 minutes so that the onions are soft but not coloured. Add the crushed garlic for the final 3 minutes.
- In a separate frying pan, heat the remaining oil and brown the cubes of lamb on all sides then add the browned meat to the casserole dish. De-glaze the frying pan with ¼ pint of tomato juice and add these juices to the pan.
- Add the remaining tomato juice, chopped tomatoes, apricots, dates, raisins or sultanas, flaked almonds, saffron, lamb stock and honey to the casserole dish. Bring to the boil, cover with a fitted lid, place in the oven and cook for 2-2½ hours or until the meat is meltingly tender.
- Place the lamb in a tagine or large serving dish and sprinkle over the chopped herbs. ■

Culinarium

Spices
Playbook 1.0

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