WORKSHOP ON REGULATORY AND FOOD SAFETY ASPECTS OF ALTERNATIVE PROTEINS FOR CONVENTIONAL ANIMAL PRODUCTS

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MEETING REPORT

WORKSHOP: REGULATORY AND FOOD SAFETY ASPECTS OF ALTERNATIVE PROTEINS FOR CONVENTIONAL ANIMAL PRODUCTS

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NOTE

The views expressed in this report are those of the participants of the Workshop: Regulatory and Food Safety Aspects of Alternative Proteins for Conventional Animal Products and do not necessarily reflect the policies of the conveners.
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Keywords: Food safety / Plant proteins, Dietary
**ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>DSE</td>
<td>Division of Health Security and Emergencies</td>
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<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<td>GFI</td>
<td>The Good Food Institute</td>
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<td>INFOSAN</td>
<td>International Food Safety Authorities Network</td>
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<td>OIE</td>
<td>World Organization for Animal Health</td>
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<tr>
<td>R&amp;D</td>
<td>research and development</td>
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<tr>
<td>WHE</td>
<td>WHO Health Emergencies Programme</td>
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SUMMARY

The global demand for proteins is changing, creating opportunities for alternative sources of proteins in the agricultural and food markets, such as cell-based and plant-based meat. As new alternative proteins become a reality, national food safety authorities need to be prepared to regulate them.

Understanding the technologies and processes behind alternative proteins production is essential to create regulations that protect consumers and allow them to make healthier choices. This prospective vision of recognizing the trajectory of technology and innovation in the global food sector, to address future food safety issues and health challenges, is consistent with the operational shifts of the For the Future vision for the Region. It is also aligned with the objective of the Regional Framework for Action on Food Safety in the Western Pacific to strengthen food safety systems and with the approach taken by the Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies (APSED III) to provide a platform for Member States, the World Health Organizations (WHO) and partners to work together.

In this regard, WHO in the Western Pacific Region convened the Workshop: Regulatory and Food Safety Aspects of Alternative Proteins for Conventional Animal Products as the first step towards supporting Member States to regulate the production, marketing and consumption of locally and imported plant-based and cultivated meat products. The workshop was held in Manila, Philippines on 19-20 May 2021. Sessions on day 1 were held at a time suitable for the Pacific island countries and areas, while those on day 2 were held at a time suitable for all other Western Pacific Region Member States. The topics were the same each day, with variation in some of the participating panellists and exhibitors. The sessions consisted of presentations and sharing by experts and country representatives. The session topics were: (1) Alternative proteins industry, market and consumer; (2) The science behind cultivated and fermented meat; (3) Panel: Science and food safety on cultivated meat production; (4) The way forward from the regulatory perspective; and (5) Panel: Regulatory aspects.

The workshop provided the Member State representatives with the concepts and scientific basis of the production of different types of alternative protein-based foods. The participants exchanged experiences on the implementation of legislation to control food safety in alternative protein-based foods.

A survey conducted during the workshop revealed that many Member States in the Western Pacific Region do not have specific regulations to control food safety in novel foods. In fact, only three Member States declared having this type of regulation. Among the challenges identified, 75% of Member States indicated the absence of national regulatory frameworks that could be applied to alternative proteins and the need for extensive discussions on the regulations and risk assessment for novel foods.

WHO in the Western Pacific Region continues to support Member States to strengthen their national food safety systems through the inclusion of adequate controls applied to alternative proteins and other novel food.
1. INTRODUCTION

1.1. Workshop organization

The Workshop: Regulatory and Food Safety Aspects of Alternative Proteins for Conventional Animal Products was held in Manila, Philippines on 19-20 May 2021. Sessions on day 1 were held at a time suitable for the Pacific island countries and areas, while those on day 2 were held at a time suitable for all other Member States. The topics were the same on each day, with variations in some of the participating panellists and exhibitors. The sessions consisted of presentations and sharing by experts and country representatives. The session topics were: (1) Alternative proteins industry, market and consumer; (2) The science behind cultivated and fermented meat; (3) Panel: Science and food safety on cultivated meat production; (4) The way forward from the regulatory perspective; (5) Panel: Regulatory aspects.

1.2. Objectives

The objectives of the workshop were:

1) to identify food safety and regulatory issues related to the novel technology of plant-based and cultivated meat; and

2) to learn from Member States that had already regulated plant-based and cultivated meat.

2. PROCEEDINGS

Fifty-two participants attended the first day of the workshop on 19 May, and 84 participants attended the second day on 20 May. Attendees included national food safety authorities, International Food Safety Authorities Network (INFOSAN) contact points and Codex Alimentarius contact points from 14 Member States in the Western Pacific Region, namely: Australia, Brunei Darussalam, Cambodia, China, Hong Kong SAR (China), the Republic of Korea, the Lao People’s Democratic Republic, Malaysia, Mongolia, Niue, the Philippines, Singapore, Solomon Islands, Vanuatu and Viet Nam. The Secretariat included WHO staff from the Western Pacific Regional Office and country offices, South-East Asia Regional Office and headquarters. Observers represented the Asian Development Bank, Food and Agriculture Organization of the United Nations (FAO), Food Industries Asia, Kyoto University and World Organization for Animal Health (OIE).

For greater detail, see Annex 1 and Annex 2 for the programme of activities and list of participants, respectively.
2.1. Opening session

Dr Simone Moraes Raszl, Food Safety Technical Officer of the WHO Regional Office for the Western Pacific, welcomed participants to the workshop. She highlighted that the general purpose of the event was to explore the scientific, technical, commercial and regulatory aspects related to the control of the food safety of alternative protein-based foods, following an approach applied to the context of food safety systems of Member States in the Region. The discussion touched upon the novel technologies of plant-based meat, fermented products and cultivated meat.

Dr Takeshi Kasai, WHO Regional Director for the Western Pacific, welcomed the participants and acknowledged the attendance of the Member States of the Region. Dr Kasai highlighted that the objective of the workshop – to explore the regulatory aspects that will be applied to alternative protein-based foods – is consistent with a prospective and preventive approach to protect consumers’ health with the application of food safety strategies for the foods that people in our Region will consume in the coming years. These approaches are aligned with the WHO vision: *For the Future: Towards the Healthiest and Safest Region*. Dr Kasai recognized that the current and future contexts in which food systems will develop are complex and challenging. Population growth, climate change and growing demand for food generate great pressure on these systems. However, these systems also exert great pressure on the global environment, making food production and consumption unsustainable. For Dr Kasai, alternative proteins pose a solution to these sustainability problems in food systems. At the same time, they represent a challenge for food safety authorities since these food innovations still carry a certain degree of uncertainty in some aspects. Establishing an adequate level of control for these novel foods is a complex task that must...
be based on scientific evidence, using a risk-based approach, in multidisciplinary and multisectoral joint work.

Dr Babatunde Olowokure, Director, Division of Health Security and Emergencies (DSE), WHO Regional Office for the Western Pacific, welcomed the participants. Dr Olowokure emphasized that the way the world produces, processes, commercializes, prepares and consumes foods has become unsustainable. At the same time, it is necessary to feed the growing global population while tackling the double burden of malnutrition. He outlined that food demand is expected to increase from 59% to 98% by 2050, with the projected demand for animal-derived protein expected to double by 2050. Substantial growth in demand could have a negative environmental impact, generating greenhouse gas emissions and requiring more water and more land. New technologies allow the production of alternative proteins without slaughtering animals, thereby generating obvious environmental, food safety and sustainability benefits. He stressed that this new innovative area poses many challenges for food safety authorities and regulators, starting with the definition of alternative cultivated products and if they should be considered as meat or a meat product. For Member States, it will be important to adjust regulatory frameworks to include new foods to protect the health of consumers. Finally, he highlighted that this workshop was the first opportunity for food safety regulators to discuss this topic and learn more about the process and the food safety aspects.

Dr Francesco Branca, Director, Department of Nutrition and Food Safety, WHO headquarters, sent a video message. Dr Branca recognized that agriculture is the second-largest producer of greenhouse gases and uses large amounts of natural resources, such as water and farmland, during production. For centuries, traditional food production systems have fed the world, but current consumption patterns are not sustainable. The world’s population is expected to grow 50% in the next three years, further increasing the demand for animal source foods. This has become a concern for sustainability. He stressed that alternatives to animal protein could contribute to more sustainable food systems. Plant-based protein, particularly from legumes, could increase the adoption of healthy diets by consumers and decrease animal source foods. Similarly, new technologies such as cultured meat, which seek to have a close resemblance to the animal-based cell culture, could solve food sustainability problems and reduce the risk of foodborne illnesses. However, it is necessary to assess the food safety and nutritional profiles of these innovations so as not to compromise the safety of food products.

Dr Guilherme Antonio da Costa Junior, Chairperson of the Codex Alimentarius Commission, highlighted the role of the Codex Alimentarius Commission as a multilateral organization that helps developing countries to apply its standards, strengthen their national food control systems and take advantage of international food trade opportunities. He pointed out that the Commission may develop Codex documents on alternative proteins in the coming years because of the initiative of any Member State. For the development of this process, aspects related to food safety, international or regional trade relevance, economic integrity and Member States’ decisions must be considered. Finally, Dr da Costa stressed that the representation of the private sector within the Codex work is essential. On that, he highlighted the addition of The Good Food Institute (GFI) as newly observed in Codex.
**Self-introductions**

With the aim of knowing and sharing the opinions and preconceptions of the audience on protein-based foods, an ice-breaker exercise was conducted to collect and display this information. The information allowed the exhibitors of the next sessions of the event to better address the specific concerns of the audience. The *Mentimeter* live survey web tool (www.menti.com) was used to ask four questions. Fig. 2 shows the results of the self-introduction survey for both days.

(a) Have you tried any alternative protein? (n=99)

(b) Would you include alternative protein-based foods as part of your diet? (n=34)

(c) What would be the main reasons to include alternative protein-based foods in your diet? (n=26)
(d) What would be the main reasons to NOT include alternative protein-based foods in your diet? (n=60)

Fig. 2. Results of the self-introduction survey

2.2. Session 1. Alternative proteins industry, market and consumer

Mrs Mirte Gosker, Acting Managing Director, The Good Food Institute (GFI), Asia Pacific, moderated the session “Alternative proteins industry, market and consumer” on both days of the workshop. Specialist presentations were made by two different exhibitors. Mrs Gosker introduced GFI as a global network whose mission is to accelerate the markets for alternative proteins, including plant-based meat, fermented products and cultivated meat, across science, business and policy.
Mr Varun Deshpande, Managing Director, GFI India (presentation on 19 May), and Ms Doris Lee, General Manager, GFI Consultancy, China (presentation on 20 May), gave presentations on industry, market and consumer perspectives for alternative proteins. Both presentations had similar objectives and the same title, but each exhibitor conducted their presentation with different approaches. Mr Deshpande oriented his presentation to describe a global panorama of the aspects of the industry, market and consumer perspectives for alternative proteins, while Ms Lee described the same aspects but with a specific focus on China.

Mr Deshpande indicated that the development of foods based on alternative proteins could have an important impact on solving the issues of sustainability, efficiency and safety that might stem from the current protein supply. He stressed that these aspects are more critical in Asia, where there is high population density, high demand for food, limited availability of livestock breeding areas, vulnerability in the supply chain of animal agriculture, outbreaks of zoonotic diseases, among other factors.

Global estimates for the year 2050 indicate that meat production must increase by about 50–70% to satisfy the growing demand for proteins. A significant portion of this demand is driven by regions like Asia. Mr Deshpande indicated that the various production modalities of animal protein available today would not be able to supply this demand in a sustainable way, and that it is necessary to diversify the origin of proteins consumed by humans, betting on more sustainable and safer options.

On this topic, both presenters pointed out that foods based on alternative proteins could diversify the supply of proteins more sustainably. Products that replicate the sensory and cultural experience of eating foods of animal origin would guarantee adequate nutrition, and at the same time, reduce costs and resource burdens in terms of water, land and carbon dioxide emissions. The categories or key pillars of these products are recognized as follows:

- **Plant-based proteins:** Plant-based meat closely resembles animal-based meat in its organoleptic properties, using one or more plant or crop ingredients. Currently, this alternative protein product has the highest production in the world, with brands and companies recognized worldwide. These products require significantly fewer resources for their production. Economic estimates show that the plant-based competitive landscape is constantly expanding, and market projections indicate an accelerated increase in the next few years.

- **Fermentation-derived proteins.** Fermentation includes the production of any microbial species for either whole-cell biomass or a valuable fraction thereof. This platform is well established, but the application is relatively new.

- **Cultivated proteins.** Cultivated meat is genuine animal meat derived from the cultivation and expansion of animal-derived muscle cells. It replicates the sensory and nutritional profiles of conventionally produced meat and is safe for consumption. Cultivated meat involves various steps, from cell line immortalization to co-culturing of various cells to large-scale optimization of meat cultivation for consumption. The cultivated meat commercial landscape has been increasing consistently, and this growth is expected to accelerate in the coming years. The technological complexity of cultivated meat production has resulted in different companies
concentrating on specific elements of the supply chain (i.e. supply chain technology segmentation).

In terms of economic and financial factors, Mr Deshpande noted that the alternative proteins food sector had experienced significant growth in global investments in recent years, particularly in the Asia–Pacific region. This situation creates an environment conducive to innovation in technologies related to these products. In Singapore, for example, there are various government initiatives to promote the development and safe consumption of alternative protein-based foods. In relation to this, Ms Lee highlighted the characteristics of China's broader landscape for alternative proteins. She described various initiatives, including: a handful of active start-ups in mainland China creating cultivated pork and seafood products; biomass fermentation to create meat substitutes for human consumption (ecosystem forming in progress); and government initiatives, such as the first national grants with an alternative protein focus in 2020. The growth dynamics of this industry is different for each type of alternative protein-based food. The plant-based food industry is older and therefore more mature and robust, with more intense economic growth. In the case of cultivated meats, the industry is much more recent, still under development, and the commercial offers are more limited. However, this industry has been emerging over the last couple of years, and it is showing significant growth.

In terms of consumption and demand for these foods, Mr Deshpande referred to studies showing that young people in urban areas are the main consumers of these products. Both presenters recognized that Asia seems to be a more conducive market for plant-based food products. This region has a long tradition of consuming these types of foods, possibly underpinned by cultural factors. Mr Deshpande showed some projections for the Asian market, with demand in China and Thailand forecasted to increase by an estimated 200% over the next five years. In the case of China, Ms Lee outlined that in 2020, plant-based meat retail sales showed a 10% year-to-year increase.

Ms Lee presented some results of studies on the perception of Chinese consumers in relation to alternative protein-based food. Regarding plant-based substitutes, Chinese consumers show the highest level of acceptance of these products in the world. One study found that a majority of Chinese respondents (73%) are willing to substitute meat with a plant-based alternative. Regarding cultivated meat, the results of some studies presented by Ms Lee indicate that most Chinese respondents are willing to try cultured meat (70%), and at least half of them (58%) are willing to buy it. Furthermore, these results show that Chinese respondents react more positively to descriptive framing of cultured meat that focuses on food safety and health benefits.

Finally, regarding the opportunities and challenges of the Chinese market for alternative proteins, Ms Lee highlighted the recent advances in national food legislation in this field. She recognized that these advances are an important driver for the development of these products in the country. The first voluntary Chinese standard for plant-based meat products (comes into effect in June 2021) has been implemented. This standard allows the partial use of an animal protein source with a maximum concentration of 10% of the feed composition.

2.3. **Session 2. The science behind cultivated and fermented meat**

Dr Katherine de Matos, Director, Science & Technology, GFI Brazil, moderated the session “The science behind cultivated and fermented meat”. Dr de Matos began by congratulating the workshop organizers for advancing the scientific debate on these new technologies and novel
foods, with the aim to protect people's health and food safety. She highlighted the fundamental role of science and technology in developing more sustainable, accessible, nutritious, healthy and safe foods based on alternative proteins. Two specialist presentations were conducted on this topic on both days.

**Specialist presentations**

Dr Liz Specht, Director of Science and Technology, GFI United States of America, presented an overview of alternative protein production platforms: plant-based proteins, microbial fermentation and cultivated meat. Dr Specht described the scientific and technical aspects involved in the different phases of the production processes of the three main groups of alternative proteins. Table 1 presents a summary of the information provided by Dr Specht on the three main groups of alternative proteins.

Dr Specht stressed that although the technological and scientific foundations applied to these alternative proteins have sufficient maturity to guarantee their industrial applicability and safe production, there are still some key challenges to address about these technologies, especially the most recent ones:

- **Need for more robust foundational open-access research and development (R&D):** Much of the current R&D is happening in the private sector, leading to redundant efforts and a tendency to focus on short-term commercial research rather than transformational innovations.

- **Supply chain constraints:** Alternative proteins will require novel crop development, innovation in ingredient fractionation and processing methods, and new predictive tools for adaptability and robustness to shifting availability of – and demand for – various biomass fractions within food and agriculture and within the broader bioeconomy.

- **Need for regulatory clarity:** Because the alternative protein sector is still nascent, especially cultivated meat, both manufacturers and suppliers to this new industry lack clarity on regulatory requirements.
Table 1. Descriptions and general considerations for production of the key pillars of alternative proteins

<table>
<thead>
<tr>
<th>Plant-based meat</th>
<th>Description</th>
<th>General consideration for production</th>
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<tbody>
<tr>
<td>Plant-based meat products are produced directly from plant-derived ingredients. Like animal products, they are composed of protein, fat, vitamins, minerals and water. Next-generation plant-based options look, taste and cook like conventional meat and offer complex carbs and fibre.</td>
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<td>Plant-based meat manufacturing processes can be adapted for different geographic considerations and cuisines. They can: (a) make use of local high-protein crops as raw materials; (b) improve protein digestibility compared to consuming whole plants; and (c) create both minced meat products and fibrous whole-cut products.</td>
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<thead>
<tr>
<th>Basic production workflow</th>
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<tr>
<td>Optimization</td>
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<tr>
<td>Source selection</td>
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<tr>
<td>Ingredient processing</td>
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<tr>
<td>Final product formulation and manufacturing</td>
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<thead>
<tr>
<th>Microbial fermentation</th>
<th>Description</th>
<th>General consideration for production</th>
</tr>
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<tbody>
<tr>
<td>Fermentation is an enabling technology for the alternative protein industry that allows the production of standalone protein sources or functional ingredients. Microorganisms can be programmed to express specific proteins or fats, or their entire protein biomass can be harvested.</td>
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<tr>
<td>Microorganisms offer enormous biological diversity and adaptability. They can: (a) make use of side streams and waste products as feedstocks; (b) add nutritional value and improve digestibility; (c) create fibrous, muscle-like structures as well as specific flavouring ingredients; and (d) grow fast – microbes can double every few hours.</td>
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<th>Basic production workflow</th>
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<tr>
<td>Strain development and target selection</td>
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<td>Feedstock optimization</td>
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<td>Bioprocess design</td>
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<td>Final product formulation and manufacturing</td>
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<table>
<thead>
<tr>
<th>Cultivated meat</th>
<th>Description</th>
<th>General consideration for production</th>
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<tbody>
<tr>
<td>Cultivated meat is produced directly from animal cells. Meat cultivation facilitates the same biological process that happens inside an animal by providing cells with the warmth and basic nutrients to build muscle and fat.</td>
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<tr>
<td>Cell cultivation offers multiple advantages to industrialized meat production: (a) elimination of public health risks from antibiotic use and zoonotic diseases; (b) faster and more resilient production processes: 4 to 6 weeks from start to finish; and (c) adaptable infrastructure: processes translate across species and product categories.</td>
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<tr>
<th>Basic production workflow</th>
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<tbody>
<tr>
<td>Cell isolation</td>
</tr>
<tr>
<td>Establishing cell line</td>
</tr>
<tr>
<td>Cell starter culture</td>
</tr>
<tr>
<td>Phase 1: Cell proliferation</td>
</tr>
<tr>
<td>Phase 2: Tissue perfusion</td>
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</tbody>
</table>

Source: Elaborated based on the presentation of Dr Liz Specht, The Good Food Institute.
• **Production capacity limitations:** Production capacity is one of the most significant constraints facing the alternative protein industry. Producers lack the right types and quantities of ingredients and other inputs, and production equipment is highly specialized and requires uncommon operational expertise.

Professor William Wei Ning Chen, Chair Professor and Director of Food Science & Technology, Nanyang Technological University, Singapore, gave a presentation on the food safety considerations of cultivated meat production. Professor Chen highlighted that his research programme at Nanyang Technological University has been working on optimizing cultured meat production technologies and reducing costs. The executed projects aim not only to improve production aspects in terms of costs but also to address food safety considerations.

According to Professor Chen’s experience, since 2014, the food science and technology programme has had difficulty attracting young researchers and demonstrating the programme’s relevance. Today, the programme focuses on simplicity and cost-effective optimization of food technology innovations to improve food systems and sustainability and guarantee national food security.

Singapore is characterized by high dependence on international food trade (more than 90%). It is imperative that the national regulatory aspects applied to food evolve rapidly in favour of solving this high dependency to avert a possible threat to national food security. Recent legislation that supports the risk assessment of cultivated meat for human consumption has facilitated the research programme led by Professor Chen to execute projects oriented to create cost-effective innovations in cultivated meat and other products.

In Professor Chen’s view, cultured meat technology has the potential to solve the coming challenges of food systems. The demand for food, especially those rich in protein, will increase considerably by the year 2050. Likewise, environmental and demographic factors will pressure and change how food is produced and consumed. Added to these are the sustainability limitations and safety risks that current traditional protein production systems represent. These challenges have been addressed by several Singapore start-ups working on projects related to alternative proteins that seek to replace the animal source ingredient and reduce production costs.

Although these novel foods represent important advantages in terms of sustainability of reducing food safety risks compared to traditional foods, these new food technologies must not cause harm to the consumer. On these safety considerations, there are still some challenges to solve. On cultured meat, Professor Chen described the key food safety considerations throughout the four production phases (Table 2).

### Table 2. Key food safety considerations for cultivated meat

<table>
<thead>
<tr>
<th>Cell collection</th>
<th>Culture process</th>
<th>Scale up</th>
<th>Final product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal source, hybrid production, microbial contamination</td>
<td>Generally recognized as safe (GRAS) medium ingredients, replacement substances, micronutrients, scaffold</td>
<td>Bioreactor, endogenously produced growth factors/ metabolites/ virus</td>
<td>Processed, unprocessed, risk assessment</td>
</tr>
</tbody>
</table>

#### 2.4. Session 3. Panel: Science and food safety on cultivated meat production
Dr Gyanendra Gongal, Regional Adviser in Food Safety, WHO South-East Asia Regional Office, moderated the panel session “Science and food safety on cultivated meat production”. Two different panels of specialists participated on each day:

- On day 1, the two panellists were Dr Samuel Tze-Kiu Yeung, Consultant in Community Medicine, Risk Assessment and Communication, Center for Food Safety, Food and Environmental Hygiene Department, Hong Kong SAR (China), and Dr Cheorun Jo, Professor of the Department of Agricultural Biotechnology, Seoul National University, Republic of Korea.

- On day 2, the two panellists were Dr Yongning Wu, Director/Head of the WHO Collaborating Centre for Food Contamination Monitoring, China National Center for Food Safety Risk Assessment, and Dr Elliot Swartz, Senior Scientist, Science and Technology Unit of GFI United States of America.

**Discussion panel**

The panel discussion was structured around four questions that sought to explore the opinions of the panellists on food safety aspects of alternative protein-based foods. The same questions were used on both days. Below are the comments provided for each question:

1. Considering that cultivated meat manufacturers use small molecule compounds to assist in the proliferation, differentiation or maturation of cells during the production process, are there potential residues of these processes that could compromise food safety? What are they and how can we prevent or minimize the risks?

   - Dr Yeung considered that some substances used during production processes might become part of the final product. This includes some of the by-products or residues of the intentional components. Some processes in the production of cultured meat require the use of small molecule compounds to assist in cell proliferation, such as the growth hormones from which metabolites can be generated. Other substances such as fetal bovine serum or environmental pollutants could be potential carriers for chemical hazards and pathogenic agents. An important part of the safety assessment is characterizing the components of the media used in production processes, as well as derived by-products, to identify potential hazards and minimize risk.

   - Dr Jo added that the use of fetal bovine serum in pre-production processes has always represented a concern for food safety in cultured meat. There could be some unknown factors in this serum that could represent a food hazard. In response to this concern, researchers and the industry are trying to replace serum with chemical substances that are safer and more controlled. The development of serum-free culture media is the next step for the safest and optimal production of cultured meat.

   - Dr Swartz considered that the totality of the risk for potential contaminants or residues in cultivated meat is expected to be far less than conventional meats and seafood. However, the unique process and the potential for unique inputs, such as small molecule compounds, could pose a food safety threat and should be examined. He proposed that the first way to minimize the risk of residues in cultivated meat would be to develop washing protocols to remove or reduce potential residues from the end product. Another potential strategy that could be applied to control these possible chemical hazards, like the conventional meats, could be to...
build databases of these potential contaminants or inputs. This information could be used to define maximum residue limits and create international standards.

- Dr Wu highlighted the role of the application of comprehensive risk assessment schemes in these novel foods. He recognized that in addition to the possibility that cultured meat contains small molecule residues with potential toxicity, there could be other substances such as additives, allergens and metabolites of genetically modified microorganisms, which, under specific conditions, could represent food hazards for consumers. Therefore, it is necessary to identify and evaluate the potential risks of all these substances, as is done for other foods.

2. Cultivated meat is expected to be either sterile or contain very low microbiological counts. Could this make cultivated meat more susceptible to cross-contamination? If so, what advice would you give to consumers and food handlers? Which additional good hygiene practices should be implemented by food industries?

- Dr Yeung highlighted that microbiology contaminations such as bacteria and viruses are common during conventional meat production and processing. Pathogens that are living in the environments and digestive tracts of live animals can contaminate the meat. In theory, cultured meat production methods, by eliminating the presence of the live animal, greatly reduce the probability of this type of contamination. However, it must be considered that the production processes applied and the characteristics of the final product provide a very favourable environment and condition for the growth of pathogens. In this sense, the standard operating protocols in hygiene measures play a fundamental role in guaranteeing the food safety of these products. The adoption of Hazard Analysis Critical Control Point (HACCP) in the manufacturing of and processing of cultured meat is crucial.

- Dr Jo outlined that although the characteristics of cultivated meat make it susceptible to the growth of microorganisms, there are many similar types of foods already distributed in the market, like pasteurized foods and sterilized foods. In this sense, the food industry already has experience in managing food safety in products very similar to cultivated meat. Therefore, it would not be necessary to develop totally new or special hygiene measures for these novel foods.

- Dr Swartz stressed that the characteristics and composition of cultured meat are like those of many other food products on the market. As such, these novel foods have a similar probability of microbiological contamination during the post-processing stages. Regarding food packaging, the technologies applied to conventional meat packaging, in principle, should also be used for cultured meat. He highlighted that sterile or very low microbiological-content food is already present on the market today. The knowledge developed for the commercialization of these products can also be applied to cultivated meat.

- Dr Wu recognized that not using live animals during food production should greatly reduce the likelihood of a microbiological hazard related to the raising and slaughter of animals in the final products. However, certain pathogens could be introduced to these foods during their processing, storage and distribution stages. For this, it is necessary to identify the critical points and other hygiene considerations that must be controlled throughout the different stages of the supply chain.
3. What are the biggest challenges in improving the nutritional characteristics of alternative protein-based food compared to conventional meat?

- Dr Yeung explained that cultured meat is designed, in principle, to emulate the characteristics of conventional meat, including nutrient composition. It must be recognized that conventional meat is a food of high nutritional value, containing all sorts of high-quality proteins, vitamins, minerals and other important nutrients. It is necessary to note that many compounds that are present in the meat are not produced by the muscles. Some nutrients are derived from animal feed and are metabolized by other cells or digested and then deposited into the muscle cells. An example of this type of nutrient is vitamin B12. The exclusive culture of muscle cells cannot generate these nutrients that are not generated in other types of cell or acquired by intake. This problem can be addressed with the application of several strategies: co-culturing cells capable of producing other nutrients or adding nutrients after the culturing.

- Dr Jo stressed the challenge in emulating all the nutritional characteristics of conventional meat. In conventional meat, the nutrient composition is complex, and the origin of the nutrients is varied. However, cultured meat can be designed and improved at any time to meet all nutritional requirements and even add new nutrients. It is only necessary to clearly understand the target composition and develop adequate strategies to include all the necessary nutrients.

- Dr Swartz pointed out that most alternative protein companies aim to create products with the same or better nutritional attributes than their conventional counterparts. Regarding macronutrient content, the amino acid profile of cultivated meat seems to be analogous to conventional meat, at least on the sort of macronutrient level that these metrics should be easily met. However, it is possible that some micronutrients or other compounds that are normally found in conventional meat may be absent or at lower levels in cultured meat. This is currently a challenge for cultured meat companies. However, like many micronutrients, these products could be fortified by adding missing micronutrients directly to the cell culture medium.

- Dr Wu stressed that conventional meat is high in nutritional value and has a known natural composition of macronutrients and micronutrients. In principle, cultured meat can be designed to emulate these nutritional characteristics. It is important to evaluate the nutritional values of conventional meat to verify that the novel food has met the nutritional requirements. Subsequently, it will be necessary to implement a certification and control system to ensure that compliance is maintained. These control schemes will eventually have to be reflected in food regulation.

4. What are the comparative advantages of alternative protein-based food in terms of food safety, prevention of zoonoses and environmental conservation?

- Dr Yeung recognized many potential advantages of alternative proteins and culture meat compared to traditional meat. One advantage is the high control of environmental factors in the production processes, which avoids the presence of environmental pollutants that can be found in traditional meat, such as heavy metals, organic pollutants, residues of veterinary drugs and pesticides. This does not imply that there is a zero probability of chemical hazards
in cultured meat. As previously mentioned, there may be substances in the culture process that could represent some risk, and these substances may contain some impurities or secondary metabolites or toxins. This is a factor that must be evaluated. Another benefit is the optimization of the areas and natural resources necessary to produce cultivated meat. This characteristic allows the production of these types of foods to be carried out in urban environments. From the perspective of zoonoses, Dr Yueng recognized that by not using live animals in the production process, the probability of occurrence of animal-to-human transmission of infectious diseases, including emerging diseases, is eliminated.

- Dr Jo agreed with the advantages described by Dr Yeung. He added that another advantage of alternative proteins is the drastic reduction of greenhouse gas emissions during the production process, as well as an optimization in the use of energy and other natural resources.

- Dr Swartz outlined some of the advantages of alternative proteins compared to conventional meats. From a food safety perspective, pathogens that cause foodborne illnesses, such as *Escherichia coli*, *Salmonella* sp. and *Campylobacter* sp., are not expected to be present in cultured meat. Similarly, the risks associated with chemical hazards, such as environmental contaminants, could be practically eliminated. The technology can also contribute reducing the risk of antibiotic resistance. In terms of environmental impact, cultivated meat would contribute to a reduction in antibiotics, other veterinary drugs and agrochemicals that affect the balance of ecosystems. Also, alternative proteins have a smaller impact on growing areas and natural resources, contributing less to greenhouse gas emissions and waste, and allowing a more efficient and sustainable way of producing foods rich in proteins. From a zoonotic disease perspective, eliminating the use of live animals in production not only contributes to reducing the risk of zoonotic diseases outbreaks but also reduces the occurrence of spill-over events associated with intensive animal operations.

- Dr Wu recognized that, in terms of food safety and zoonotic diseases, cultured meat production could be considered safer for health. However, as in the case of any other food, food contamination could occur in the stages after primary production. For this, the application of food safety control systems is important. On the other hand, optimizing the use of crop areas and natural resources in the protein production process is an important advantage for countries like China, where efficient ways of producing large quantities of food are required. Likewise, the reduction of environmental emissions in the production of cultivated meat is a relevant factor.

2.5. **Session 4. The way forward from the regulatory perspective**

Mr Gustavo Guadagnini, Managing Director, Board of The Good Food Institute, Brazil, moderated the session “The way forward from the regulatory perspective”. Mr de Matos highlighted the importance of having spaces for participatory discussion in the process of formulating food legislation, bringing together academic, technical, business and regulatory perspectives to build adequate institutional frameworks. He commented that GFI is an observer of the Codex Alimentarius committees and is contributing to the development of international
standards that guarantee the food safety of protein-based foods. Two specialist presentations were conducted on this topic.

**Specialist presentations**

The first presentation was made by Dr Matthew O’Mullane, Section Manager, Standards & Surveillance, Australian Delegation Leader, Codex Committee on Contaminants in Foods, Food Standards Australia New Zealand. Dr O’Mullane made a comprehensive description of the Australian regulatory perspectives on alternative proteins.

In an introductory way, Dr O’Mullane described the main elements of the Australia / New Zealand Food Regulation System, including general food requirements set forth in the Food Standards Code and specific requirements for certain points in the food chain or for some types of food. Most of the general requirements of this legal framework would apply to alternative protein-based foods, such as cultured meat. However, there are certain specific legal requirements applicable to novel foods. For example, the application for marketing these types of foods must be accompanied by a pre-market risk assessment, which, among other things, looks at the safety and suitability of that food or a component of food.

This pre-market risk assessment process, like other legal requirements, is driven by specific definitions for the identity of a particular food or substance to be added to food, and the purpose of that substance to be added to food. In the case of alternative protein-based foods, the characteristics of the food, the history of consumption in the protein’s country of origin and the food additives used will push a particular pre-market assessment pathway. This makes a difference in the evaluation processes and levels of regulatory intervention of a plant-based protein or originating from a fermentation process or cultured meat. Based on these considerations, Australia / New Zealand Food Regulation establishes three levels of regulatory intervention. Table 3 shows a summary of these levels applied to alternative proteins.

**Table 3. Australia / New Zealand Food Regulation: level of regulatory intervention applied to alternative proteins**

<table>
<thead>
<tr>
<th>Plant-based meat</th>
<th>Microbial fermentation</th>
<th>Cultivated meat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category</strong></td>
<td><strong>Existing proteins and/or substances</strong></td>
<td><strong>New protein sources and/or substances</strong></td>
</tr>
<tr>
<td><strong>Level of regulatory intervention</strong></td>
<td><strong>Low</strong></td>
<td><strong>High</strong></td>
</tr>
<tr>
<td><strong>Main considerations for control</strong></td>
<td>- Make use of existing protein sources and ingredients/substances</td>
<td>- Proteins and substances without a history of food use in the country (plant and animal proteins, new additives, etc.)</td>
</tr>
<tr>
<td></td>
<td>- History of safe use as foods</td>
<td></td>
</tr>
</tbody>
</table>
Dr O’Mullane stressed that in the case of cell-cultured proteins, some factors, such as the lack of a harmonized nomenclature and relatively limited direct experience in the management of these foods, make it difficult to predict the level of regulatory intervention that is appropriate. On this, several existing food standards would apply, such as identity and purity, nutritional and safety controls, additive control, nutrient content, maximum levels of contaminants, among others. However, the process of deciding which existing standards should be applied or which new standards should be created will be driven by several considerations. Based on this information, Table 4 shows the main considerations and factors that are contemplated within the Australia / New Zealand Food Regulation to apply an adequate level of regulatory intervention to cell-cultured protein products.

**Table 4. Australia / New Zealand Food Regulation: main considerations for the application of an adequate regulatory intervention to cell-cultured protein products**

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Factor</th>
<th>Applied example</th>
<th>Regulatory implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production process characteristics</td>
<td>- Production technologies</td>
<td>Gene technology including genetic modifications</td>
<td>Genetically modified food could have specific legislation.</td>
</tr>
<tr>
<td></td>
<td>- Using processing aids</td>
<td>Growth factors such as hormones, filtration aids</td>
<td>Pre-market assessment of those constituents</td>
</tr>
<tr>
<td></td>
<td>- Types of controls</td>
<td>Process controls are in place to manage the risk from things like potential microbiological or chemical contamination.</td>
<td>Application of regulatory controls or creation of new tools such as production standard or code of practice</td>
</tr>
<tr>
<td>Composition</td>
<td>- Similarity to conventional meat</td>
<td>Side-by-side comparison of cell-cultured skeletal muscle and</td>
<td>Product identity (genetically and phenotypically) and designation requirements</td>
</tr>
</tbody>
</table>

Example:
- Lentil burger
- Soy meat products
- Rapeseed protein isolate
- Soy leghemoglobin
- Chicken bites made from chicken cells grown in bioreactors
skeletal muscle obtained from an animal

- Nutrient content
  Fortification with vitamins or minerals added
  Require some level of regulatory and consideration

- Food safety
  Presence of chemical or microbiological hazards, conventional or new
  Application of general and specific food safety regulation

- Food suitability and quality
  Adequate sensory characteristics of the final product
  Specific standards and code of practice

<table>
<thead>
<tr>
<th>Intended use or function</th>
<th>- Nutritive purpose</th>
<th>Declaration of special nutritional properties</th>
<th>Nutritive purpose standard and nutritive substance standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Food oriented to special sectors</td>
<td>Products intended for infant formula</td>
<td>Specify regulation and important policy considerations</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumption patterns</th>
<th>- Substitute foods</th>
<th>The product intended as a replacement for existing foods</th>
<th>Include these factors in exposure assessments.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Consumption intensity</td>
<td>High intensity of food consumption in a specific subpopulation</td>
<td>Include these factors in exposure assessments.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Policy guidance</th>
<th>- Local government policies</th>
<th>Political positions and provisions of local governments on these products</th>
<th>Include these factors in the regulatory development cycle.</th>
</tr>
</thead>
</table>

The second presentation was made by Mr Low Teng Yong, Deputy Director, Regulatory Policy Department, Singapore Food Agency, Singapore. Mr Low Teng Ying described Singapore’s experiences in the regulation of alternative proteins. He began by introducing the Singapore Food Agency (SFA), which was formed on 1 April 2019. This national agency aims to ensure and secure a supply of safe food and seeks to bring together all food-related resources and capabilities for the holistic management of the food industry "from farm to fork”.

Mr Low Teng Yong explained that Singapore has a set of national strategies comprising three food baskets to ensure a supply of safe food for its people:

- **Diversify import sources**: Reduces risk of reliance on any one supply source.
- **Grow local**: Helps mitigate Singapore’s reliance on imports, serves as a buffer during supply disruptions and aims to transform the agri-food industry into one that is highly productive, employing climate-resilient and sustainable technologies.
- **Grow overseas**: Supports companies to expand and grow overseas so that their produce can be exported to Singapore.

Likewise, there are other national strategies aimed at achieving national food and nutritional security, under current and future global conditions: The “30 by 30 Goal” aims to raise local production of nutritional needs to 30% by 2030 in a sustainable way. This is a great challenge since Singapore currently produces less than 10% of the food consumed. To achieve this goal, the Government is funding a comprehensive R&D programme, the "Singapore food story ID program”, which costs US$ 106 million to implement. The R&D programme covers three pillars (Table 5).
Table 5. Structure of Singapore’s R&D programme

<table>
<thead>
<tr>
<th>Pillar</th>
<th>Expected outcome</th>
<th>Example</th>
</tr>
</thead>
</table>
| I. Sustainable Urban Food Production| Increase productivity; lower resources and operational costs; improve disease and health management; improve nutritional quality of produce | • Genetics  
• Nutrition  
• Disease and health management  
• IT tech: Smart sensors for urban production systems  
• Nutrient and quality preservation for farm produce |
| II. Future Foods: Advanced Biotech-based Protein Production | Develop novel biotech-based methods; position Singapore as a leading alternative protein R&D hub; enable circular bioeconomy; improve sustainability | • Discovery  
  Computational biology; cell-based cultured Meat  
  • Translational  
  Microbial protein, plant protein, scale-up |
| III. Food Safety Science & Innovation | Address emerging challenges in food safety and quality through science; develop new food standards | • Food safety science for emerging risks  
• Intelligent supply chain  
• Understanding consumer behaviour towards food |

Mr Low Teng Yong highlighted that Singapore’s food policies and strategies have promoted the development and commercialization of new food technologies, such as cultured meat. From the perspective of the health authority, guaranteeing food safety control within these accelerated innovation processes is a challenge. Regulatory food safety strategies applied to alternative proteins are based on a clear understanding of the different categories of alternative protein-based foods and their characteristics. These categories include plant-based protein, mycoprotein, algal protein, insect protein, cellular/cultured meat. From this, it can be recognized that some of these alternative proteins have been consumed for many years, and as such, authorities already know the related food safety risks and have applicable legislation in place. On the other hand, for alternative proteins that do not have a history of human consumption, Singapore does not have regulations and lacks data to understand the food safety risks involved. This last subgroup of alternative proteins meets the characteristics of a “novel food”. According to Singaporean legislation, novel foods are (1) foods and food ingredients that do not have a history of use for human consumption (i.e. 20 years) or (2) compounds that are chemically identical to naturally occurring substances but produced through advances in technology. This difference makes it possible to distinguish alternative proteins considered as a novel food.

Table 6. Singapore food regulation: relationship between alternative proteins and novel foods

<table>
<thead>
<tr>
<th>Alternative protein</th>
<th>Is this a novel food?</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultured meat or seafood</td>
<td>Yes</td>
<td>Cell-cultured animal or seafood</td>
</tr>
<tr>
<td>Acellular agriculture</td>
<td>Yes</td>
<td>B-lactoglobulin produced by \textit{Trichoderma reesei}</td>
</tr>
<tr>
<td>Algal and fungi-based protein</td>
<td>Possibly depending on species</td>
<td>\textit{Chlamydomonas reinhardtii} algae</td>
</tr>
<tr>
<td>Insect protein</td>
<td>Possibly depending on species</td>
<td>Black soldier fly larvae</td>
</tr>
</tbody>
</table>
The characteristics of novel foods, including some alternative proteins, were used as criteria for applying specific regulatory interventions. As the main measure, a pre-market safety assessment was established for novel food products in order to safeguard the health of consumers. These requirements and the application obligations have been described in the national standard, Requirements for the Safety Assessment of Novel Foods. This document aims to provide food businesses with a better understanding of requirements regarding the safety assessment for novel foods. This standard has a specific section for cultured meat, which requires information to be submitted for the safety assessment of cultured meat. Information required may change based on developments in the science of producing cultured meat. With this information, the SFA will carry out a comprehensive review of safety assessment to: (1) ascertain whether the potential food safety issues have been addressed by identifying food safety hazards, identifying whether published scientific literature contradicts information submitted, and evaluating whether mitigating steps taken to manage potential risks are effective; and (2) consider the health impact of the novel food when consumed as intended, including estimate dietary exposure to novel food, and evaluate the impact on safety.

2.6. Session 5. Panel: Regulatory aspects

Mr Alfonso Vargas and Ms Frida Esther Sparaciari, Food Safety Consultants for the WHO Regional Office for the Western Pacific, were the moderators of the panel session “Regulatory aspects” for days 1 and 2, respectively. A single panel of specialists participated on both days. They included Dr Tom Heilandt, Codex Secretary, and Dr Sarah Cahill, Senior Food Standards Officer, Codex Alimentarius Commission, and Madam Zailina Abdul Majid, Deputy Director, Food Safety and Quality Division, Ministry of Health, Malaysia.

Discussion panel

The panellists answered four questions that sought to explore their opinions on some regulatory aspects of alternative proteins. Below are the responses provided for each question:

1. Which existing Codex standards apply to alternative proteins?

- Dr Cahill mentioned that Codex Alimentarius has general standards, which are generic or cross-cutting standards, as well as commodity standards that apply to a particular type of food product. She said that many of the safety and quality aspects of new products like alternative protein sources could be addressed with generic standards, such as the General Principles of Food Hygiene. She added that allergens, which might be an important aspect to consider when looking at alternative proteins, could be addressed in the recently adopted Code of Practice for the management of allergens in food. Another important aspect for
alternative proteins might be chemical contaminants. She noted that Codex Alimentarius has several standards on contaminants in food, such as residues from veterinary drugs and pesticides. Pesticide residue is especially relevant for plant proteins.

Dr Cahill highlighted that the Codex Alimentarius does not have texts specifically applied to alternative proteins such as cultivated meat. There are some old standards relating to vegetable protein products (VPP) and foods derived from modern technology, but new standards will be developed in the specific areas of alternative proteins. She mentioned some of the discussions that recently took place at the Codex Committee on Contaminants in Food. The idea of edible insects as a possible source of protein source was brought up again, and a discussion on the safety of this food followed. The Committee agreed that this was a cross-cutting issue that needed a holistic approach within Codex. She added that some interesting developments are going to happen in this area in the future.

2. How will Codex Alimentarius address potential new threats to consumer health from these new products?

- Dr Cahill outlined that one of the goals of Codex is to look at new and emerging issues in food safety. To identify these emerging issues, the different Codex committees adopt mechanisms to provide a pathway for Member States to raise their concerns about new and emerging products.

Dr Heilandt highlighted that Codex has mechanisms to address the concerns of Member States with scientific advice. The scientific bases of Codex include procedures for the formation of ad hoc expert consultation groups to evaluate the risks associated with a specific food or hazard. These mechanisms can be applied to alternative proteins.

3. Will Codex develop new commodity standards for these products?

- Dr Heilandt indicated that the process for the development of Codex commodity standards is born from the initiative of the Member States. The same applies to alternative proteins. However, he recognized that the alternative protein food industry is constantly growing and that these foods are expected to be involved in international trade. These are some of the factors that promote the development of international standards. Based on this, Dr Heilandt believes these types of standards will be developed in the coming years.

- Dr Cahill added that it is necessary to look forward to the technological progress of the food industry and that it is important to maintain an open mind in the development of future Codex standards. She stressed that the Codex standards must be developed to meet the current needs.

4. What are the main challenges for the control of alternative protein-based foods?

- Madam Zailina Abdul, a national food safety authority, recognized that it is challenging for food safety authorities to deal with the outputs of the innovation process of the food industry
and the entry of novel food products in the market, especially for developing countries. She described the main challenges as follows:

- **Regulation development**: Keeping the food regulation up to date with developments in the food industry and following the global trajectories of technological innovations in the sector are great challenges for a food safety authority.

- **Information availability**: Having adequate data and information is the basis for the decision-making process of competent authorities. This factor has a direct impact on the application of adequate food control, and this information is a key input to the regulatory and policy design process. In the case of developing specific product standards, it is necessary to have information, and it can be limited for novel foods. This includes information related to the nature of the product and the associated food hazards and risks. It is also essential to assess the risks of introducing a novel food in the local market.

- **Food labelling**: Labelling gathers the main information of a food and makes it available to consumers so that they can make decisions on the purchase of food. In the case of novel foods, such as alternative proteins, it is challenging to establish adequate requirements for labelling. For this, it is necessary to know the characteristics and composition of the food product. In that sense, the role of the national health authority is to ensure that food in the market is safe and the information provided by the consumer is correct.

5. Regarding food inspection activities: How could the conventional elements of an animal source foods inspection system be varied to carry out a cultured meat inspection?

- Madam Zailina outlined that food inspection activities applied to alternative proteins should follow the general principles of food inspection. She believes that part of the current animal source foods inspection system could still apply to novel foods. However, to address the peculiar characteristics of alternative proteins during inspection activities, it will be necessary to carry out some adaptations. On this, the nature of these novel foods could generate a change in the parameters related to the microbiological aspects. In the case of cultured meat, this meat is expected to grow in a very strict condition control environment, which limits the likelihood of the presence of pathogens in these foods. This affects the way these foods are inspected. Another factor is the type of production process and how the control systems of the food operators adapt to these characteristics. Inspectors should be prepared to evaluate these control systems with new features. She stressed that including all relevant factors in the process of adapting inspection activities applied to alternative proteins will allow an authority to achieve better control over these foods.

2.7. **Closing remarks**

Dr Raszl described the workshop as a great learning experience on innovations in food and food safety and a good opportunity to exchange experience and knowledge of the scientific, technical, commercial and regulatory aspects applied to alternative proteins. She thanked the participation of all attendees, especially the experts and the representatives of the Member States who shared their experiences in these fields.
Dr Raszl stressed that current and future global conditions require humanity to change how we produce, process, trade, prepare and eat our food towards a more sustainable food system. In this scenario, alternative proteins can be a game changer in this process. However, it is necessary to ensure that these foods are safe and that we have appropriate food regulations to provide optimal protection for consumers’ health. She referred to the words mentioned by Dr Takeshi Kasai at the beginning of the workshop, who highlighted that to face the next food safety challenges, it is necessary to think about health beyond the health sector. This implies that it is necessary to include this topic in the environmental agenda of Member States, as well as consider the demographic changes and include partnerships.

Finally, Dr Raszl emphasized that there is no such thing as “risk free” when we talk about food safety. In a changing world, we face complex phenomena with new technologies. Food safety is everyone’s business, and in that sense, it is necessary to work together now to ensure health for tomorrow. Food safety national systems must be able to regulate not only the alternative proteins but all foods that are offered to the populations.

2.8. Survey results

During the workshop, a short survey on aspects of the institutional framework applied to alternative proteins was applied. The survey aimed to explore the level of applicability of the current food safety regulatory framework of Member States of the Western Pacific Region related to alternative protein-based foods. The survey comprised 22 questions that addressed general aspects, assessment processes of novel food products, production and commercialization and communication and food labelling. The design of the questionnaire was based on multiple references from an exhaustive review of the scientific literature. Annex 3 shows the questionnaire used. The survey was applied using the Microsoft Forms web tool.

From the application of the survey, 36 responses were obtained during the workshop, which corresponded to representatives of 12 Member States of the Western Pacific Region and other participants representing external organizations. Following up on the established questionnaire, the first question asked Member States if they had a specific regulation for importing and/or developing novel foods. Out of the 12 Member States that responded to the survey, nine answered that they do not have a specific regulation for these purposes.

Depending on the answer to the first question, i.e. whether or not the Member State has a specific regulation for importing and/or developing novel foods, the survey posed different questions. The results obtained for both groups are shared below.

**Member States that do not have a specific regulation**

Nine Member States responded not having a specific regulation for importing and/or developing novel foods. Representatives were asked whether their institutional and/or legislative framework has any other official instrument (e.g. regulation, procedure, programme, communication campaign) applicable to novel foods. Only two of the nine Member States without a specific regulation acknowledged having an instrument applicable to novel foods. These instruments included low-level legal provisions (administrative orders) that established risk classification criteria for these products.
Member States were then asked about the likelihood of implementing specific legislation for alternative proteins-based food in the next two years. A numerical scale from 0 to 10 was used to indicate the probability of implementing a regulation, where 0 is unlikely and 10 is very likely. As shown in Fig. 3, four Member States responded that it is possible (value 5) to initiate these legislative development processes. Only two Member States considered it more likely to implement regulations in the coming years, and three Member States considered it less likely.

![Fig. 3. Analysis of the perception of the probability of implementation of specific regulation for alternative proteins in nine Member States of the Western Pacific Region](image)

**Member States that have specific regulations**

Representatives of the three Member States that have a specific regulation for importing and/or developing novel foods were consulted on the types of food safety controls included in the regulation. This included the answer to 18 specific questions.

Table 7 shows the results obtained for these three Member States for each topic evaluated. In all three cases, it can be observed that the national regulatory framework complies with most of the evaluated aspects of food safety, risk assessment, controls during production and marketing, and communication and food labelling. However, in some cases, it was observed that there are some topics that are still implemented or are still under development.
Table 7. Analysis of specific topics included in the regulatory framework applied to alternative proteins in three Member States of the Western Pacific Region

<table>
<thead>
<tr>
<th>General aspects of the institutional framework</th>
<th>Australia</th>
<th>China</th>
<th>Singapore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific regulation for de entry and/or development of novel foods</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Includes food safety aspects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Formal definition and classification of alternative protein food</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Competent authorities accountable for controlling the food safety of novel food or alternative protein food</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Specific regulation that establishes control criteria for alternative protein food products, including microbiological criteria, maximum levels of chemical contaminants, purity and others</td>
<td>Partially</td>
<td>Partially</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment of novel food products</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific procedures to carry out risk assessment and authorization of alternative protein food products before they are marketed</td>
<td>Yes</td>
<td>Yes</td>
<td>Under development</td>
</tr>
<tr>
<td>Procedures to carry out the risk assessment for alternative protein food products have a differentiated approach between products of meat substitutes and cultured meat.</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Guidelines for the industry on the application of procedures to carry out the risk assessment for alternative protein food products</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Assessment procedures formally consider reference studies developed by foreign health authorities.</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>The procedures to carry out the risk assessment for alternative protein food include the evaluation of factors of conditions for growth of pathogenic microorganisms, kinetics and toxicity, nutritional profile, allergenicity.</td>
<td>Yes, all of them</td>
<td>Yes, all of them</td>
<td>Partially</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Production and commercialization</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Official requirements for the food businesses that intend to produce, import and sell alternative protein food products</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Specific inspection protocols to check if the manufacturing process and company controls will produce alternative protein food products that comply with food safety regulations</td>
<td>Yes</td>
<td>Yes</td>
<td>Under development</td>
</tr>
<tr>
<td>Specific registry for companies that manufacture alternative protein food products</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>There are companies authorized to market / import / produce alternative protein food products</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Specific surveillance activity for the alternative protein food products that circulate on the market</td>
<td>No</td>
<td>No</td>
<td>No</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication and labelling</th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Specific legal requirements for labelling of alternative protein food products</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Specific legal requirements in the advertising and marketing of alternative protein food products</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Official communication strategies for consumers on the food safety of alternative protein food products</td>
<td>Under development</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Expectation on the role of the WHO Western Pacific Regional Office

As the last question in the questionnaire, all respondents were asked about their expectation of the role of the WHO Western Pacific Region Office to support adaptation processes to improve the Member State regulatory framework to include better controls on alternative proteins.

Table 8 lists the results of the analysis of the respondents’ comments. In general, it is observed that there is a significant demand from Member States for actions by WHO in strengthening national regulatory frameworks applied to alternative proteins. This includes providing technical support, training, publication of guidelines and standards, execution of events, promoting collaboration in the Region and promoting harmonization of standards.

Table 8. Expectation on the role of WHO in strengthening regulatory frameworks applied to alternative proteins

<table>
<thead>
<tr>
<th>Topics</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical support</td>
<td></td>
</tr>
<tr>
<td>- Develop legal frameworks and related procedures for implementation at the country level</td>
<td>7</td>
</tr>
<tr>
<td>- Capacity-building on better controls of foods based on alternative proteins</td>
<td>1</td>
</tr>
<tr>
<td>- Research and risk assessment</td>
<td>1</td>
</tr>
<tr>
<td>- Risk communication</td>
<td>1</td>
</tr>
<tr>
<td>Training (legal aspects, risk assessment)</td>
<td>5</td>
</tr>
<tr>
<td>Fund support</td>
<td>2</td>
</tr>
<tr>
<td>Publications</td>
<td></td>
</tr>
<tr>
<td>- Codes of practice and guidelines</td>
<td>3</td>
</tr>
<tr>
<td>- Publication of the workshop’s report</td>
<td>1</td>
</tr>
<tr>
<td>Execution of events (workshops, conferences)</td>
<td>3</td>
</tr>
<tr>
<td>Promote regional collaboration</td>
<td></td>
</tr>
<tr>
<td>- Strengthen intergovernmental exchanges</td>
<td>4</td>
</tr>
<tr>
<td>- Technical cooperation</td>
<td>1</td>
</tr>
<tr>
<td>Promote harmonization of standards</td>
<td>4</td>
</tr>
</tbody>
</table>
3. CONCLUSIONS AND RECOMMENDATIONS

3.1. Conclusions

- The workshop provided the Member State representatives with concepts and scientific basis of the production of different types of alternative protein-based foods. The participants exchanged experiences on the implementation of legislation for the control of food safety of alternative protein-based foods.
- The survey conducted during the workshop revealed that many Member States still do not have specific regulations to control food safety in novel foods. Only three Member States declared having this type of regulation.
- Among the challenges identified, 75% of Member States indicated the absence of national regulatory frameworks that could be applied to alternative proteins and the need for extensive discussions on the regulations and risk assessment for novel foods. They also highlighted that food inspectors need to be trained on novel technologies to produce alternative food proteins.
- Production and consumption of alternative proteins are increasing. As these novel foods become more common in markets, Member States must be prepared to regulate and control their production and marketing.

3.2. Recommendations

3.2.1. Recommendations for Member States

Considering the responses from the surveys applied during the workshop, and in order to be ready to regulate alternative proteins and guarantee their safety for consumers, Member States are encouraged to:

1. Promote scientific dialogues on alternative protein-based food at the national level to improve knowledge of technology and safety of novel foods.
2. Engage all national food safety stakeholders, such as regulatory authorities, Codex Alimentarius contact points, the private sector, academia and consumers, in the development or adaptation of regulations applied for alternative proteins, considering national contexts and risk assessments.
3. Prepare food safety inspectors with the technical knowledge necessary to perform inspections of novel food products.
4. Review and adapt existing regulations while taking account of alternative proteins.
5. Propose the Codex Alimentarius Commission to initiate the discussion on existing and future needs on international standards for novel foods produced by cultivated meat.

3.2.2. Recommendations for WHO
The WHO Secretariat is requested to:

(1) Facilitate the intergovernmental exchange of knowledge between Member States that have already implemented regulations and those that seek to include them.
(2) Provide technical support to Member States to develop and/or adapt regulations for alternative proteins.
(3) Support regional or international working groups that will be formed over the next few years for the development of guidelines and standards for alternative protein-based foods, following the procedures of the corresponding international organizations, such as the Codex Alimentarius.
(4) Coordinate a multisectoral and multi-stakeholder group to develop a comparative study of risk assessment and the hazard analysis and critical control points from conventional and alternative food products.

3.2.3. Recommendations for partners

It is recommended to partners:

(1) Codex Alimentarius Commission:
   (a) Consider forming ad hoc expert consultation groups to evaluate the risks associated with alternative proteins and the need for revision of existing standards, guidelines and codes of practices.
   (b) Initiate the discussion on existing and future needs on international standards for novel foods produced from cell culture, as requested by Member States.

(2) Good Food Institute:
   (a) Share information and participate in the evaluation of risks associated with alternative proteins.
   (b) Support scientific dialogues with food safety national authorities, WHO and Codex Alimentarius ad hoc groups.
   (c) Foster collaboration among the private sector and academia to solve technological gaps and provide scientific information to stakeholders.

(3) Academia
   (a) Share knowledge and actively participate in the evaluation of risks associated with alternative proteins.
   (b) Include technologies for alternative protein in curricula.
   (c) Support scientific dialogues with food safety national authorities, WHO and Codex Alimentarius ad hoc groups.
   (d) Provide training for food inspectors related to alternative proteins.

(4) Private sector
   (a) Comply with food safety and general principles of hygiene standards.
   (b) Cooperate in sharing information and knowledge related to the production of
alternative proteins to be used by risk assessors and risk managers.

(c) Work with academia to seek solutions for filling technology gaps in the production of alternative proteins.
# ANNEXES

## Annex 1. Programme of activities

<table>
<thead>
<tr>
<th>Time</th>
<th>Activities</th>
<th>Speaker (Moderator)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1: Wednesday, 19 May 2021</td>
<td>Opening Session</td>
<td></td>
</tr>
<tr>
<td>07:00 – 07:40</td>
<td>1. Welcome and opening remarks</td>
<td>Dr Takeshi Kasai, Regional Director, WHO/WPRO (TBC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr Babatunde Olowokure, Regional Emergency Director (RED), WHO Health Emergencies Programme (WHE) / Director, Division of Health Security and Emergencies (DSE), WHO/WPRO</td>
</tr>
<tr>
<td></td>
<td>2. Self-introductions (mentimeter)</td>
<td>Dr Francesco Branca, Director, Department of Nutrition and Food Safety, WHO/HQ</td>
</tr>
<tr>
<td></td>
<td>3. Overview of objectives and agenda</td>
<td>Dr Guilherme Antonio da Costa Junior, Chairperson, CODEX Alimentarius Commission</td>
</tr>
<tr>
<td></td>
<td>4. Administrative announcements</td>
<td>Dr Simone Moraes Raszl, Technical Officer, Food Safety, WHO/WPRO</td>
</tr>
<tr>
<td></td>
<td>5. Group photo (virtual)</td>
<td></td>
</tr>
<tr>
<td>07:40 – 07:55</td>
<td>Alternative proteins industry, market &amp; consumer</td>
<td>Moderator: Mrs Mirte Gosker, Acting Managing Director, The Good Food Institute, Asia Pacific</td>
</tr>
<tr>
<td></td>
<td><strong>Industry, market &amp; consumer perspectives for alternative proteins</strong></td>
<td>Mr Varun Deshpande, Managing Director, The Good Food Institute, India</td>
</tr>
<tr>
<td>07:55 – 08:20</td>
<td>The Science behind cultivated and fermented meat</td>
<td>Moderator: Dr Katherine de Matos, Director, Science &amp; Technology, The Good Food Institute, Brazil</td>
</tr>
<tr>
<td>Time</td>
<td>Activities</td>
<td>Speaker (Moderator)</td>
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<tr>
<td>Overview of alternative protein production platforms: plant-based proteins, microbial fermentation, and cultivated meat</td>
<td>Dr Liz Specht, Director of Science and Technology, The Good Food Industries, United States of America</td>
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<tr>
<td></td>
<td>Food Safety Considerations on Cultivated Meat Production</td>
<td>Professor William Wei Ning Chen, Chair Professor and Director, Food Science &amp; Technology, Nanyang Technological University, Singapore</td>
</tr>
<tr>
<td>08:20 - 08:30</td>
<td>Panel: Science and food safety on cultivated Meat Production</td>
<td>Moderator: Dr Gyanendra Gongal, Regional Adviser (Food Safety), WHO/SEARO</td>
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<tr>
<td></td>
<td></td>
<td>Dr Samuel Tze-Kiu Yeung, Consultant (Community Medicine, Risk Assessment and Communication), Center for Food Safety, Food and Environmental Hygiene Department, Hong Kong</td>
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<td></td>
<td></td>
<td>Dr Cheorun Jo, Professor, Department of Agricultural Biotechnology, Seoul National University, Korea</td>
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<tr>
<td>08:30 – 08:40</td>
<td>Coffee break</td>
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<tr>
<td>08:40 – 09:00</td>
<td>The way forward from the regulatory perspective</td>
<td>Moderator: Mr Gustavo Guadagnini, Managing Director, Board, The Good Food Institute, Brazil</td>
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<tr>
<td></td>
<td>Regulatory Update on Cultivated Meat</td>
<td>Dr Matthew O'Mullane Section Manager, Standards &amp; Surveillance, Australian Delegation Leader, Codex Committee on Contaminants in Foods Food Standards Australia New Zealand</td>
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<tr>
<td></td>
<td>Singapore Experience</td>
<td>Mr Low Teng Yong, Deputy Director, Regulatory Policy Department, Singapore Food Agency, Singapore</td>
</tr>
<tr>
<td>9:00 – 9:15</td>
<td>Panel: Regulatory aspects</td>
<td>Moderator: Mr Alfonso Isaías Vargas Huaco, Consultant, Food Safety, WHO/WPRO</td>
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<tr>
<td>Time</td>
<td>Activities</td>
<td>Speaker (Moderator)</td>
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<tr>
<td>9:15 – 9:30</td>
<td>Question and answer</td>
<td>Dr Simone Moraes Raszl, Technical Officer, Food Safety, WHO/WPRO</td>
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<tr>
<td></td>
<td>Closing remarks</td>
<td>Madam Zailina Abdul Majid, Deputy Director Food Safety and Quality Division, Ministry of Health, Malaysia</td>
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<td></td>
<td></td>
<td>Dr Sarah Cahill, Senior Food Standards Officer, Codex Alimentarius</td>
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<td>Dr Tom Heilandt, Codex Secretary, Codex Alimentarius</td>
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**Day 2: Thursday, 20 May 2021**

<table>
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<tr>
<th>Time</th>
<th>Activities</th>
<th>Speaker (Moderator)</th>
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<tr>
<td>10:00 – 10:40</td>
<td>Opening Session</td>
<td>Dr Takeshi Kasai, Regional Director, WHO/WPRO (TBC)</td>
</tr>
<tr>
<td></td>
<td>1. Welcome and opening remarks</td>
<td>Dr Babatunde Olowokure, Regional Emergency Director (RED), WHO Health</td>
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<tr>
<td></td>
<td>2. Self-introductions (mentimeter)</td>
<td>Emergencies Programme (WHE) / Director, Division of Health Security and Emergencies (DSE), WHO/WPRO</td>
</tr>
<tr>
<td></td>
<td>3. Overview of objectives and agenda</td>
<td>Dr Francesco Branca, Director, Department of Nutrition and Food Safety, WHO/HQ</td>
</tr>
<tr>
<td></td>
<td>4. Administrative announcements</td>
<td>Dr Guilherme Antonio da Costa Junior, Chairperson, CODEX Alimentarius Commission</td>
</tr>
<tr>
<td></td>
<td>5. Group photo (virtual)</td>
<td>Dr Simone Moraes Raszl, Technical Officer, Food Safety, WHO/WPRO</td>
</tr>
<tr>
<td>Time</td>
<td>Activities</td>
<td>Speaker (Moderator)</td>
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</tr>
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<td>10:40 – 10:55</td>
<td>Alternative proteins industry, market &amp; consumer</td>
<td>Moderator: Mrs Mirte Gosker, Acting Managing Director, The Good Food Institute, Asia Pacific</td>
</tr>
<tr>
<td></td>
<td>Industry, market &amp; consumer perspectives for alternative proteins</td>
<td>Ms Doris Lee, General Manager, GFI Consultancy, China</td>
</tr>
<tr>
<td>10:55 – 11:20</td>
<td>The Science behind cultivated and fermented meat</td>
<td>Moderator: Dr Katherine de Matos, Director, Science &amp; Technology, The Good Food Institute, Brazil</td>
</tr>
<tr>
<td></td>
<td>Overview of alternative protein production platforms: plant-based proteins, microbial fermentation, and cultivated meat</td>
<td>Dr Liz Specht, Director of Science and Technology, The Good Food Industries, United States of America</td>
</tr>
<tr>
<td></td>
<td>Food Safety Considerations on Cultivated Meat Production</td>
<td>Professor William Wei Ning Chen, Chair Professor and Director, Food Science &amp; Technology, Nanyang Technological University, Singapore</td>
</tr>
<tr>
<td>11:20 - 11:30</td>
<td>Panel: Science and food safety on cultivated Meat Production</td>
<td>Moderator: Dr Gyanendra Gongal, Regional Adviser (Food Safety), WHO/SEARO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr Yongning Wu, Director/Head, WHO Collaborating Centre for Food Contamination Monitoring, China National Center for Food Safety Risk Assessment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr Elliot Swartz, Senior Scientist, Science and Technology, The Good Food Institute, United States of America</td>
</tr>
<tr>
<td>11:30 – 11:40</td>
<td>Coffee break</td>
<td></td>
</tr>
<tr>
<td>11:40 – 12:00</td>
<td>The way forward from the regulatory perspective</td>
<td>Moderator: Mr Gustavo Guadagnini, Managing Director, Board, The Good Food Institute, Brazil</td>
</tr>
<tr>
<td>Time</td>
<td>Activities</td>
<td>Speaker (Moderator)</td>
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<tr>
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</tr>
<tr>
<td>12:00 – 12:15</td>
<td>Regulatory Update on Cultivated Meat</td>
<td>Dr Matthew O'Mullane Section Manager, Standards &amp; Surveillance, Australian Delegation Leader, Codex Committee on Contaminants in Foods Food Standards Australia New Zealand</td>
</tr>
<tr>
<td></td>
<td>Singapore Experience</td>
<td>Mr Low Teng Yong, Deputy Director, Regulatory Policy Department, Singapore Food Agency, Singapore</td>
</tr>
<tr>
<td>12:15 – 12:30</td>
<td>Panel: Regulatory aspects</td>
<td>Moderator: Ms Frida Esther Sparaciari, Consultant, Food Safety, WHO/WPRO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr Tom Heilandt, Codex Secretary, Codex Alimentarius</td>
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<td>Dr Sarah Cahill, Senior Food Standards Officer, Codex Alimentarius</td>
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<tr>
<td></td>
<td></td>
<td>Madam Zailina Abdul Majid, Deputy Director Food Safety and Quality Division, Ministry of Health, Malaysia</td>
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<tr>
<td>12:15 – 12:30</td>
<td>Question and answer</td>
<td>Dr Simone Moraes Raszl, Technical Officer, Food Safety, WHO/WPRO</td>
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<tr>
<td></td>
<td>Closing remarks</td>
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</tbody>
</table>
Annex 2. List of participants

1. PARTICIPANTS

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### Annex 3. Short-survey question list

1. **General aspects of the institutional framework** [9 questions]

   1.1. Is there a specific regulation for the entry and/or development of novel foods?  

      *(If the answer to question 1.1 is "No") [3 questions]*

      1.1.1. In the institutional/legislative framework of your Member State, is there any other official instrument (regulation, procedure, program, communication campaign) applied to novel foods?  

      1.1.2. From the last question, indicate to which ones  

      1.1.3. From your personal perspective: How likely is it that in the next two years your Member State will include specific legislation for foods based on alternative proteins?  

      *(Continue to question 5.3.) [5 questions]*

      *(If the answer to question 1.1 is "Yes")*

      1.2. Does the existing regulation, or the draft (under development) include food safety aspects?  

      1.3. Is there a formal definition and classification of alternative protein food products in the existing or under development regulation?  

      1.4. Are there competent authorities accountable for controlling the food safety of novel food or alternative protein food products?  

      1.5. Is there a specific regulation that establishes control criteria for alternative protein food products, including microbiological criteria, maximum levels of chemical contaminants, purity, and other aspects?  

      1.6. From the last question, indicate to which criteria

2. **Assessment of novel food products** [5 questions]

   2.1. Are there specific procedures to carry out risk assessment and authorization of alternative protein food products before they are marketed?  

   2.2. Do the procedures to carry out the risk assessment for alternative protein food products have a differentiated approach between products of meat substitutes (e.g., plant-based meat, insects) and cultured meat (e.g., stem cells, cell culture, tissue engineering)?  

   2.3. Are there guidelines for the industry on the application of procedures to carry out the risk assessment for alternative protein food products?  

   2.4. Do the assessment procedures formally consider reference studies developed by foreign health authorities?  

   2.5. Do the procedures to carry out the risk assessment for alternative protein food include the evaluation of factors of: conditions for growth of pathogenic microorganisms, kinetics and toxicity, nutritional profile, allergenicity?

3. **Production and commercialization** [5 questions]

   3.1. Are there official (formal?) requirements for the food businesses that intend to produce, import, and sell alternative protein food products?  

   3.2. Are there specific inspection protocols to check if the manufacturing process and company controls will produce alternative protein food products comply with food safety regulations?  

   3.3. Is there a specific registry for companies that manufacture alternative protein food products and their products?  

   3.4. Currently, are there companies authorized to market, import, produce alternative protein food products?  

   3.5. Has any specific surveillance activity been implemented for the alternative protein food products that circulate on the market?  

4. **Communication and labeling** [3 questions]

   4.1. Are there specific legal requirements for labelling of alternative protein food products?  

   4.2. Are there specific legal requirements in the advertising and marketing of alternative protein food products?  

   4.3. Have official communication strategies been implemented for consumers on the food safety of alternative protein food products?

5. **Final** (1 question)

   5.3. How do you expect the WHO WPRO to support your organization to adapt or improve the regulatory framework of your Member State to include better controls on foods based on alternative proteins?