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Editorial

The need to consider the "functional quality" dimension in the holistic evaluation of animal-sourced foods

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The quality of animal-sourced foods (ASFs) is commonly evaluated through a set of well-established properties, organized into intrinsic and extrinsic dimensions. The intrinsic dimensions are directly related to the product itself and include sensory, nutritional, technological, commercial, safety, and convenience properties, while the extrinsic dimension (also referred to as image) is associated with production/transformation and farming practices, such as animal welfare, environmental impacts, farming conditions, traceability, and broader societal perceptions [1]. These intrinsic and extrinsic dimensions are now proposed to be integrated within the conceptual framework of One Quality [2], which aims to provide a holistic and systemic evaluation of ASFs quality by explicitly linking product properties, production systems, and societal expectations. The One Quality framework represents a significant conceptual advance by acknowledging that ASFs quality cannot be reduced to isolated properties but instead emerges from interactions between biological, technological, environmental, ethical, and socio-economic factors along multiple properties across the continuum from farm-to-fork.

However, despite this integrative approach, the biological effects of ASFs on human health are still primarily interpreted through the lens of conventional "nutritional dimension", which remains largely limited to macro (proteins, lipids, etc.) and micronutrient composition (vitamins, minerals, such as iron, zinc, and calcium, fatty acids, etc.) and their density and bioavailability. While this perspective remains valid, it is increasingly clear that nutritional composition alone does not capture the full biological value of foods. Two foods with similar nutrient profiles may therefore exert very different physiological outcomes. In ASFs, this limitation is particularly evident. For example, protein quality is often assessed through amino acid composition and digestibility indices, yet protein digestion also leads to the release of peptides (during tenderization, ripening, or fermentation) with specific biological activities. These effects are not captured by conventional nutritional metrics. Thus, the nutritional

composition perspective alone does not fully capture the complexity of ASFs as biological matrices capable of generating other important functions such as bioactive compounds during processing and digestion [3–8], nor does it account for their potential to modulate physiological functions beyond the satisfaction of basic nutritional requirements [6,9,10]. In fact, proteolysis during food processing (e.g., meat aging, artificial meat tenderization, fermentation) and gastrointestinal digestion releases peptides and protein hydrolysates from animal proteins that exhibit diverse biological activities. These include antihypertensive, antioxidant, antimicrobial, immunomodulatory, and opioid-like effects [6,7]. Milk-derived peptides are among the most studied, but meat, egg, and fish proteins are also recognized sources [5]. For instance, peptides derived from myofibrillar and sarcoplasmic proteins can inhibit angiotensin-converting enzyme (ACE), thereby contributing to blood pressure regulation. Importantly, these peptides are generated as a consequence of digestion and are therefore intrinsically linked to the way ASFs interact with the human organism.

Despite extensive scientific evidence, the capacity of ASFs to act as precursors of bioactive peptides is not considered in quality evaluation systems. Meat tenderness, for example, is partially driven by proteolysis, yet the downstream biological consequences of this proteolysis are ignored [11]. ASFs also provide a variety of lipids with functional properties, including long-chain omega-3 fatty acids, conjugated linoleic acid (CLA), phospholipids, and sphingolipids [12]. These compounds have been associated with the modulation of inflammation, lipid metabolism, cognitive function, and cardiovascular health. The content and composition of these lipids are influenced by animal species, feeding systems, and processing conditions [13,14]. However, current quality assessments typically reduce lipid evaluation to total fat content and fatty acid profiles, without considering functional or bioactive implications [15,16]. Fermented dairy products represent another clear example of functional potential in ASFs. Yogurt, kefir, and many cheeses deliver live microorganisms or microbial metabolites that interact with the gut microbiota and host physiology [17]. These interactions may influence immune function, gut barrier integrity, and metabolic regulation [18]. Yet, even in fermented ASFs, quality evaluation rarely includes functional endpoints related to microbiota modulation or host response. The presence of live cultures is often treated as a technological or marketing feature rather than a dimension of quality.

Consequently, even within the emerging One Quality framework, an explicit consideration of the functional consequences of consuming ASFs remains underdeveloped. This observation highlights a conceptual gap: while intrinsic quality dimensions describe what the product is and extrinsic dimensions describe how it is produced, neither explicitly addresses what the product does biologically once consumed beyond the nutritional quality viewpoint. Addressing this gap requires the recognition of a distinct "functional quality" dimension, complementary to the six other intrinsic properties, which reflects the capacity of ASFs to exert physiological effects through bioactive peptides, functional lipids, microbial metabolites, and other digestion- or processing-derived compounds. Integrating a "functional quality" dimension into the integrative framework would therefore strengthen its biological relevance and improve the alignment between ASFs quality evaluation and contemporary advances in nutrition and health sciences.

One might argue that these aspects are already covered under the broad concept of functional foods. However, this concept is insufficient for several reasons. First, functional food is typically used as a product category, often associated with fortification, reformulation, or specific health claims. It does not provide a framework for evaluating the intrinsic properties of conventional ASF. Second, the functional food concept has historically been applied more extensively to plant-based foods, leading

to an implicit bias that positions ASFs primarily as sources of basic nutrition rather than functional bioactivity. Third, regulatory approaches to functional foods vary widely across regions and often focus on substantiated health claims rather than on food quality per se. In contrast, the notion of a "functional quality" dimension emphasizes that functionality is an inherent dimension of food quality, arising from the natural composition, structure, and digestion of the product, rather than from external enrichment. The "functional quality" dimension can then be described as the capacity of an ASF, through its intrinsic composition, structure, and digestion, to generate biologically active compounds or physiological effects that contribute to health beyond the nutritional composition. This description deliberately places functionality at the interface between food composition and biological response. It recognizes that functional effects may emerge during digestion and metabolism, not only from compounds present in the food as consumed. Importantly, the "functional quality" dimension should be considered orthogonal to other quality dimensions, since a product may be nutritionally adequate but functionally poor, and conversely, a product with modest nutrient content may exert significant functional effects. By emphasizing biological functionality rather than mere nutrient provision, this perspective provides a scientific basis for a "less but better" approach to ASFs (meat) consumption [19–21], in which reduced quantities may be offset by higher functional and physiological value.

Explicitly recognizing "functional quality" as a distinct and additional dimension of ASFs quality would represent a conceptual advancement, included in the One Quality approach development, with significant implications for research, production, regulation, and public health. Rather than positioning ASFs defensively within nutritional debates mainly in comparison to their alternatives, this approach acknowledges their full biological potential and aligns their evaluation with modern understanding of food-health relationships.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Conflict of interest

The author declares no conflict of interest.

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