考試科目：食品加工與食品化學
學系組名稱：食品科學系碩士班食品科學組

1.答案以橫式由左至右書寫在**答案卷**上。2.請依題號順序，並標示題號作答。

1. 請寫出食品冷凍或冷凍儲藏時可能產生之三種品質變化因子，並分別說明其原因及其防止方式。(9 分)

2. 請以含水率為橫軸、乾燥速率為縱軸，畫出食品之乾燥速率曲線(drying rate curve)。配合圖說明食品乾燥依照其乾燥速率可分為哪些階段?分別說明其特徵及原因?(11 分)

3. 請舉例兩種非熱加工 (non-thermal processing) 技術，並說明其原理及應用。(10 分)

4. 請分別說明魚漿製品 (煉製品) 及乾酪 (cheese) 如何製造，請詳述其製造流程及製造原理。(20 分)

5. 請詳讀以下二段文字並回答以下問題:
   (1) 請以中文寫出 100-150 字的摘要。(10 分)
   (2) 請以中文或英文寫出 20 字以內的標題。(2 分)
   (3) 請從文獻編號 (98-100) 中挑出一篇論文說明內文主旨。(6 分)
   (4) 請從內文中舉例說明你了解的分析儀器及其原理。(7 分)

   Recent applications have demonstrated the potential of metabolomics approaches to evaluate food traceability and investigate molecular changes during food processing. Thus, analytical methods based on HR-MS instruments; mainly using hybrid Q-TOF-MS or Q-Orbitrap-MS analyzers, hyphenated mainly to UHPLC, are the most widely reported. The most used chromatographic separations are based on C18 columns for metabolomics applications, whereas HILIC stationary phases are the option of choice for lipidomics. Mobile phases composed of water and acetonitrile with different modifiers (i.e., 0.1% formic acid, ammonium formate) are frequently used. ESI or heated electrospray ionization (HESI) sources are the most popular and widespread used interfaces in HR-MS based metabolomics coupled to LC techniques, operating in positive ESI mode; although some approaches are reported to operate in both positive and negative ESI modes to obtain complementary structural information. **(98)**

   HR-MS-based metabolomics has been proposed to investigate qualitative traits of meat, allowing the simultaneously detection of a wide range of metabolites related to processing, ripening, and shelf life conditions of meat products. For instance, the molecular processes promoted by the addition of three different microbial starters (i.e., *Pediococcus pentosaceus*, *Staphylococcus xylosus*, and *Lactobacillus sakei*) during the manufacturing of dry-fermented salami was investigated by Rocchetti et al. **(99)** The untargeted UHPLC-Q-Orbitrap-MS analysis revealed that each microbial

starter imposed distinctive metabolomic signatures at the end of ripening, involving lipids (including hydroxy and epoxy derivatives of fatty acids) and γ-glutamyl peptides that contribute to the final sensorial quality of products. Rocchetti et al. also performed an untargeted screening of dry fermented sausage metabolites by UHPLC-Q-TOF-MS. **(100)** Fermented sausages produced following a cold drying-ripening process at the lower relative humidity values (65%–80%) showed several oxidation markers at the end of ripening, such as oxy and hydroxy derivatives of fatty acids. In the first study, the collected raw data obtained from Orbitrap were converted into .abf format and further processed using the software MS-DIAL, and annotated via spectral matching against the MoNA database. **(99)** In the latest study, the raw mass features from Q-TOF were processed in the software Profinder (Agilent Technologies), based on the targeted "find-by-formula" algorithm, and the identification of meat metabolites was achieved against the comprehensive database FoodDB. **(100)**

(Adopted from *Anal. Chem.* 2022, 94, 1**,** 366–381 entitled as **Foodomics: Analytical Opportunities and Challenges**)

6. 請比較食品中畜肉、魚肉與植物肉的物理、化學、生化、代謝、一般組成、營養特性及相關性質。(15 分)

7. 請分別說明反式脂肪 (trans fat)、丙烯醯胺 (acrylamide)、4-甲基咪唑 (4-methylimidazole)、黃麴毒素 (alphatoxin) 和糖化終產物 (advanced glycation end products) 在食品加工中如何產生?以及在食品化學中代表的意義?(10 分)