

2026 The Graduate School of Systems Life Sciences

Kyushu University

Special Screening For International Students

(Division of Life Engineering/ Cellular Regulation Technology)

注意

1. Do not open the test booklet until the signal to begin answering is given.
2. There are two sheets of exam paper (including the cover) and three sheets of answer paper (A4 size).

Use one sheet of answer paper per question. When doing so, write the question number you are answering on the answer sheet.

3. After the exam begins, first confirm that all the papers are present.
4. Please write your exam number and name on each of the three answer sheets.
5. If there is not enough space for your answers, please use the back of the answer sheet.

Question 1: Answer the following questions.

- 1) List examples of foods known to improve skin condition.
- 2) Explain the mechanism by which these foods are thought to improve skin function.

Question 2: Answer the following questions.

Human aging is thought to be determined by genetic and environmental factors.

Provide examples for each.

Question 3: Answer the following questions.

List the advantages and disadvantages of using animal cell cultures in biopharmaceutical production.

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Question 1: Answer the following questions.

(Purpose of the Question) This question assesses the basic knowledge of the regulation of biological functions in food required for research in the Master's program at the Graduate School of Systems Life Sciences.

1) List examples of foods known to improve skin condition.

(Model Answer)

- Collagen-rich foods (e.g., bone broth, fish skin): support skin elasticity and structure
- Vitamin C-rich foods (e.g., citrus fruits, strawberries, bell peppers): promote collagen synthesis and act as antioxidants
- Polyphenol-rich foods (e.g., green tea, cocoa, berries): reduce oxidative stress and inflammation
- Carotenoid-rich foods (e.g., carrots, tomatoes, spinach): protect against UV-induced damage and improve skin appearance
- Omega-3 fatty acid-rich foods (e.g., salmon, mackerel, flaxseed): reduce inflammation and maintain skin barrier function
- Fermented foods (e.g., yogurt, kimchi): improve gut microbiota, influencing skin via the gut-skin axis
- Nuts and seeds (e.g., almonds, sunflower seeds): provide vitamin E and essential fatty acids for skin protection

2) Explain the mechanism by which these foods are thought to improve skin function.

(Model Answer)

Foods that improve skin condition act through several complementary biological mechanisms:

First, antioxidant effects play a central role. Vitamins (such as vitamin C and E), carotenoids,

and polyphenols scavenge reactive oxygen species (ROS), thereby reducing oxidative damage to lipids, proteins, and DNA in skin cells. This helps prevent photoaging and maintains cellular integrity.

Second, these foods promote collagen synthesis and inhibit its degradation. Vitamin C is essential for collagen biosynthesis, while polyphenols can suppress matrix metalloproteinases (MMPs), enzymes that degrade collagen and elastin. As a result, skin elasticity and dermal structure are preserved.

Third, anti-inflammatory effects contribute to improved skin function. Omega-3 fatty acids and polyphenols reduce the production of pro-inflammatory cytokines, thereby alleviating chronic low-grade inflammation that leads to skin aging and disorders.

Fourth, they support skin barrier function and hydration. Essential fatty acids (e.g., omega-3s) are incorporated into cell membranes and the stratum corneum, improving barrier integrity and reducing transepidermal water loss.

Fifth, via the gut-skin axis, fermented foods and dietary fibers modulate gut microbiota composition. This leads to the production of beneficial metabolites (such as short-chain fatty acids) and reduced systemic inflammation, which in turn positively affects skin homeostasis.

Finally, recent studies suggest that dietary components may regulate cellular signaling pathways (e.g., SIRT1, AMPK) and even influence intercellular communication (e.g., exosomes), contributing to enhanced mitochondrial function, reduced cellular senescence, and improved skin regeneration.

Question 2: Answer the following questions.

Human aging is thought to be determined by genetic and environmental factors. Provide examples for each.

(Purpose of the Question) This question assesses advanced knowledge of aging

regulation necessary for research in the Master's program at the Graduate School of Systems Life Sciences.

(Model Answer)

Genetic factors include inherited traits that affect lifespan and aging processes. For example, variants in genes such as FOXO3 are associated with longevity in humans. Additionally, genetic disorders like Hutchinson–Gilford progeria syndrome, caused by mutations in the LMNA gene, lead to accelerated aging, demonstrating that specific genes can strongly regulate aging. Family studies and twin studies also show that lifespan tends to cluster within families, indicating a heritable component.

Environmental factors include external and lifestyle-related influences. For example, diet (e.g., caloric intake, nutrient composition) can affect metabolic health and aging rate. Physical activity is associated with improved mitochondrial function and reduced age-related decline. Smoking and UV exposure accelerate aging by increasing oxidative stress and DNA damage, particularly in tissues such as the skin. In contrast, healthy lifestyles, including balanced nutrition and regular exercise, are associated with increased healthspan.

Question 3: Answer the following questions.

List the advantages and disadvantages of using animal cell cultures in biopharmaceutical production.

(Purpose of the Question) This question assesses basic knowledge of substance production using animal cells, which is necessary for research in the Master's program at the Graduate School of Systems Life Sciences.

(Model Answer)

Advantages:

- Proper post-translational modifications: Animal cells (e.g., CHO cells) can perform complex modifications such as glycosylation, folding, and disulfide bond formation, which are essential for the activity of many therapeutic proteins.
- Production of complex proteins: Suitable for producing monoclonal antibodies, hormones, and other biologics that cannot be correctly synthesized in prokaryotic systems.
- High product quality and functionality: Proteins produced are structurally and functionally similar to native human proteins.
- Established regulatory acceptance: Widely used in industry with well-developed manufacturing and quality control frameworks.

Disadvantages:

- High production cost: Requires expensive media, growth factors, and strict culture conditions.
- Slow growth rate: Animal cells grow more slowly than microorganisms, leading to longer production times.
- Sensitivity to culture conditions: Cells are fragile and require precise control of pH, temperature, and oxygen.
- Risk of contamination: Potential contamination with viruses or other adventitious agents necessitates rigorous safety testing.
- Lower yields compared to microbes: Generally produce lower amounts of product than bacterial or yeast systems.