

大葉大學 98 學年度 研究所博士班 招生考試試題紙

系 所 別	組 別	考 試 科 目 (中文名稱)	考 試 日 期	節 次	備 註
生物產業科技學系博士班	甲組	專業英文論文閱讀能力測驗	6月14日	第 1 節	第一頁

註：考生可否攜帶計算機或其他資料作答，請在備註欄註明（如未註明，一律不准攜帶）

注意事項

請就下列十題中任選五題作答，每題 20 分，答題時請務必填寫「題號」，未清楚標示「題號」之答案或作答超過五題以上之答案不列入評分。

第一題

Four acidic heteroglycans, T2a-T2d, were isolated from the body of *Tremella fuciformis* Berk. They contained 1.9%-2.9% of acetyl groups and were composed of mannose (Man), glucuronic acid (GlcA), and small amounts of xylose (Xyl), glucose (Glc), and fucose (Fuc). According to methylation analysis they had a mannan backbone consisting of 3-linked Man, and side chains containing glucosyl, mannosyl, fucosyl, xylosyl, and glucuronic acid residues. The side chains were attached through O-2, O-4, or O-6 in about 40 percent of backbone mannosyl residues. Molecular masses of the four polysaccharides were 410, 250, 34, and 20 kDa, respectively. T2a-T2d induced human monocytes to produce interleukin-1 (IL-1), interleukin-6 (IL-6), and tumor necrosis factor (TNF) *in vitro*. The products of Smith degradation (T2a-S) and lithium degradation (T2a-L) of T2a and the product of deacetylation (T2b-D) of T2b also induced monocytes to secrete IL-1 as efficiently as the original polysaccharides, indicating that xylosyl and glucuronic acid residues as well as acetyl groups were not important to promote the cytokine-stimulating activity.

第二題

The essential oil of rose-scented geranium (*Pelargonium* species, family: Geraniaceae) obtained through steam or water plus steam distillation of shoot biomass is extensively used in the fragrance industry and in aromatherapy. During distillation, a part of the essential oil becomes dissolved in the distillation water (hydrosol) and is lost as this hydrosol is discarded. In this investigation, hydrosol was shaken for 30 min with hexane (10:1 proportion) and the hexane was distilled to yield 'secondary' or 'recovered' essential oil. The chemical composition of secondary oil was compared with that of 'primary' oil (obtained directly by distilling shoot biomass of the crop). Primary oil accounted for 93.0% and secondary oil 7.0% of the total oil yield (100.2 ml from 100 kg green shoot biomass). Fifty-two compounds making up 95.0-98.5% of the primary and the secondary oils were characterized through gas chromatography (GC) and gas chromatography-mass spectroscopy (GC-MS). Primary oil was richer in hydrocarbons (8.5-9.4%), citronellyl formate (6.2-7.5%), geranyl formate (4.1-4.7%), citronellyl propionate (1.0-1.2%),  $\alpha$ -selinene (1.8-2.2%), citronellyl butyrate (1.4-1.7%), 10-*epi-c*-eudesmol (4.9-5.5%) and geranyl tiglate (1.8-2.1%). Recovered oil was richer in organoleptically important oxygenated compounds (88.9-93.9%), commercial rhodinol fraction (74.3-81.2%), sabinene (0.4-6.2%), cislinool oxide (furanoid) (0.7-1.2%), linalool (14.7-19.6%),  $\alpha$ -terpineol (3.3-4.8%) and geraniol (21.3-38.4%). Blending of recovered oil with primary oil is recommended to enhance the olfactory value of the primary oil of rose-scented geranium. Distillation water stripped of essential oil through hexane extraction can be recycled for distilling the next batch of rose-scented geranium.

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第三題

Excessive intake of salt causes hypertension and the World Health Organization recommends that its daily intake be restricted to 6 g/d. It is a common practice to substitute part of salt with vinegar, which may make up the reduced saltiness. In fact, addition of some acid to a food is known to enhance its saltiness in case the salt concentration is low. A study published in the *Journal of Food Science* shows that the addition of vinegar to salt intensified the salty taste. Interaction of saltiness and acidity at the threshold level was studied employing 35 to 40 young female panelists. As a first step, the researchers measured the detection and recognition thresholds of salt, rice vinegar, and rice black vinegar for each panelist. To investigate the above interaction, the thresholds were again measured for each panelist of salt, but this time, vinegar at half the concentration of each panelist's detection threshold was added to the salt solution. Similar measurement was performed for vinegars with salt at half the concentration of each panelist's detection threshold.

第四題

Overexpression of bacterial-derived starch metabolic enzymes in plant starch storage organs represents a valuable strategy for improving starch quality, bioprocessing and nutritional value. Transgenic rice seeds producing a thermostable and bifunctional starch hydrolase, amylopullulanase (APU) from *Thermoanaerobacter ethanolicus* 39E, were generated. Starch in these seeds could be hydrolyzed with optimal temperatures between 85 and 95 °C, which resulted in complete conversion of starch into soluble sugars and production of protein-enriched flour within a few hours. By expressing various levels of APU, rice seeds containing reduced amounts of amylose, which is an important factor affecting starch quality, were obtained without a significant impact on grain yield. Elevation in granule-bound pullulanase activity correlates with the reduction of amylose in developing APU-containing rice seeds. APU was found to be localized within amyloplasts and in cell walls, which could be the result of overexpression of APU with a signal peptide. This study establishes novel approaches to alter starch properties, accelerate bioprocessing of starch and production of protein-enriched flour from rice seeds, and could significantly impact the industrial and food uses of cereals.

第五題

Ethanol production in tubular bioreactor integrated with the membrane distillation (MD) system has been investigated. The fermentation of sugar with *Saccharomyces cerevisiae* proceeds with the formation of by-products, which tends to inhibit the yeast productivity. The removal of by-products from the fermenting broth by MD process increased the efficiency and the rate of sugar conversion to ethanol. The fermentation process carried out in the membrane bioreactor with the yeast concentration of 20 g dm<sup>-3</sup> resulted in the productivity of 5.5 g EtOH dm<sup>-3</sup> h and the efficiency closed to 95%, after 20 h. The productivity decreased to 2.6 g EtOH dm<sup>-3</sup> h with the efficiency below 50% for the fermentation under similar conditions, but without MD. The separation of alcohol by MD enabled to achieve a higher content of ethanol in the permeate than that in the broth. The enrichment coefficient amounted to 2–6 were depended on the ethanol concentration in the feed. The presence of yeast cells in the feed increased the concentration and

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the temperature polarization, consequently the ethanol flux through the membrane was reduced by ca. 50%. A beneficial effect of carbon dioxide presence in the feed on the ethanol flux was found. The evolution of CO<sub>2</sub> bubbles from the fermenting broth enhanced the turbulence in the boundary layer, hence the ethanol transport through the membrane increased.

第六題

*Melaleuca alternifolia* (Cheel) is an Australia native tree harvested for its monoterpene-rich, essential oil. Monoterpene synthases (E.C. 4.2.3.20) were partially purified from the flush growth of the commercially important, high terpinen-4-ol chemotype of *M. alternifolia*. The purified fractions produced an acyclic monoterpene, linalool that is not present in the essential oil. To further characterise the monoterpene synthase, a cDNA library was constructed and 500 expressed sequence tags (ESTs) were sequenced to isolate putative terpene synthases. A single clone with similarity to the *TspB* gene sub-family of angiosperm monoterpene and isoprene synthases was isolated but was truncated at the 5' end. This single clone was used to design a probe for a cDNA library and was applied to isolate a full-length clone. This gene encoded a polypeptide 583 amino acids in length (67 kDa) including a putative transit peptide. Heterologous expression of the gene in *Escherichia coli* and subsequent assay of the recombinant enzyme did not result in the production of terpinen-4-ol, the major constituent of tea tree oil, or of its precursor sabinene hydrate. Significant quantities of linalool were observed in these assays, and in the assays of monoterpene synthase activity of a native enzyme in vitro, but the racemic nature of the linalool means that it may have a non-enzymatic origin.

第七題

It may be easy to start smoking, but quitting is a bit trickier. The brain of an addicted smoker treats nicotine as if it is essential for survival. Genetic traits may predispose some smokers to stronger addiction. Most smokers try to quit unaided, resulting in a high failure rate. If you smoke, no one needs to tell you how bad it is. So why haven't you quit? Why hasn't everyone? Because smoking feels good. It stimulates and focuses the mind at the same time that it soothes and satisfies. The concentrated dose of nicotine in a drag off a cigarette triggers an immediate flood of dopamine and other neurochemicals that wash over the brain's pleasure centers. Inhaling tobacco smoke is the quickest, most efficient way to get nicotine to the brain.

第八題

The mechanism of water uptake in low moisture cereals and cookies has been studied by NMR relaxometry and solid imaging technology implemented on a low-resolution benchtop NMR spectrometer. A comparison between classical MRI and SPRITE imaging are also presented to highlight the benefits of each technology. The spin lattice (T<sub>1</sub>) and spin spin (T<sub>2</sub>) relaxation times, the 1D and 2D SPRITE imaging, were determined on Smacks™, corn flakes, chocolate chips cookies, soft caramel candies with a chocolate cre`me filler, and corn starch/water systems. The Smacks™ and corn flakes were studied based on the soaking time in milk, and the results showed that T<sub>1</sub> and T<sub>2</sub> decreased in the first 20 sec of soaking and then increased with the soaking time. For Smacks™ stored at different relative humidity, T<sub>1</sub> decreased during the first day

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of storage and then was relatively constant over storage time indicating that the system reached an equilibrium. 1D SPRITE profiles indicated an increase in signal intensity over storage time for cookies in 58% RH. However, the moisture uptake was insignificant indicating that the water mobility (and not the amount of water) changed due to various chemical interactions in the system (hydrogen bonding, starch retrogradation, glassy/rubbery equilibrium). The T1 and T2 of corn starch/water systems decreased as the concentration in starch increased and temperature increased from 30°C to 60°C. However, for temperatures higher than 60°C, the relaxation times increased showing more mobility and flexibility of the polymer chains during gelatinization.

第九題

In plants, low temperature and dehydration activate a set of genes containing C-repeat/dehydration-responsive elements in their promoter. It has been shown previously that the Arabidopsis CBF/DREB1 transcription activators are critical regulators of gene expression in the signal transduction of cold acclimation. Here, we report the isolation of an apparent homolog of the CBF/DREB1 proteins (CBF4) that plays the equivalent role during drought adaptation. In contrast to the three already identified CBF/DREB1 homologs, which are induced under cold stress, CBF4 gene expression is up-regulated by drought stress, but not by low temperature. Overexpression of CBF4 in transgenic Arabidopsis plants results in the activation of C-repeat/dehydration-responsive element containing downstream genes that are involved in cold acclimation and drought adaptation. As a result, the transgenic plants are more tolerant to freezing and drought stress. Because of the physiological similarity between freezing and drought stress, and the sequence and structural similarity of the CBF/DREB1 and the CBF4 proteins, we propose that the plant's response to cold and drought evolved from a common CBF-like transcription factor, first through gene duplication and then through promoter evolution.

第十題

Biosensors based on whole-cell bioluminescence have the potential to become a cost-effective alternative to conventional detection methods upon validation of target selectivity and sensitivity. However, quantitative analysis of bioluminescence is greatly hindered due to lack of control over the total number of cells in a suspending culture. In this study, the effect of surface properties of genetically engineered luminous *E. coli* cells and fibrous matrices on the immobilization capacity and effectiveness under various environmental conditions were characterized. Four different fibers, including cotton, polyester, viscose rayon, and silk, were investigated. Although cell adhesion was observed on untreated viscose and cotton fibers, viscose fiber pretreated with 0.667% polyethyleneimine (PEI) was found capable of immobilizing the most viable *E. coli* DPD2234 cells, followed by viscose treated with 0.33% and 1% PEI. The cells immobilized on PEI-treated viscose remained viable and yielded 20% or more bioluminescence signals immediately upon contact with the inducer up to 72 h without feeding nutrients to the cells, suggesting that viscose treated with 0.667% PEI could provide a stable immobilization mechanism for bioluminescent *E. coli* cells with long sensing period, quick response time, and good signal reproducibility.