UNIVERSITI SAINS MALAYSIA

Supplementary Semester Examination
Academic Session 2009/2010

June 2010

IMK 209 – PHYSICAL PROPERTIES OF FOOD
[SIFAT-SIFAT FIZIKAL MAKANAN]

Duration: 2 hours
[Masa: 2 jam]

Please check that the examination paper consists of **TWENTY THREE (23)** pages of printed material before you begin this examination.

Answer **FOUR** questions. Section A is COMPULSORY. Answer any THREE questions from Section B. The answer script and the question paper for Section A will be collected one hour (1 hour) after the commencement of examination. All questions can be answered in Bahasa Malaysia OR English.

In the event of any discrepancies, the English version shall be used.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **DUA PULUH TIGA (23)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.*

*Jawab **EMPAT** soalan. Bahagian A adalah WAJIB. Jawab mana-mana TIGA soalan dari Bahagian B. Kertas jawapan dan kertas soalan Bahagian A akan dikumpul satu jam (1 jam) selepas peperiksaan bermula. Semua soalan boleh dijawab dalam Bahasa Malaysia ATAU Bahasa Inggeris.*

Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai].

SECTION A (Compulsory)
There are 25 questions in this section. Answer ALL questions in the OMR form. Section A question sheet will be collected together with the OMR form 1 hour after examination starts.

1.1 Glass capillary viscometers are not suitable for this sample:
A. Orange juice
B. Clear apple juice
C. Thin honey
D. Barley drink

1.2 Which of the followings are not true for capillary glass viscometers?
I. These viscometers are suitable only for measuring viscosity of Newtonian fluids
II. These viscometers can be used to measure viscosity of non-Newtonian fluids
III. These viscometers are suitable only for measuring viscosity of fluids free of suspended solids
IV. These viscometers can be used to measure viscosity of opaque liquids

A. II and IV
B. II
C. I and III
D. II and III

1.3 Which of the following instruments give viscosity readings in fundamental unit (Pa s)?
A. Brookfield viscometer
B. Brabender Amylograph
C. Falling ball viscometer
D. Bostwick consistometer

1.4 Which of the following rheological models is suitable to fit data for shear thinning fluid without yield stress?
A. Casson
B. Herschel-Bulkley
C. Power Law
D. Cross

1.5 The viscosity of Newtonian fluids is influenced by the:

I. Shear rate
II. Previous shear history
III. Temperature
IV. Concentration

A. I and III
B. II, III, and IV
C. III and IV
D. II and IV

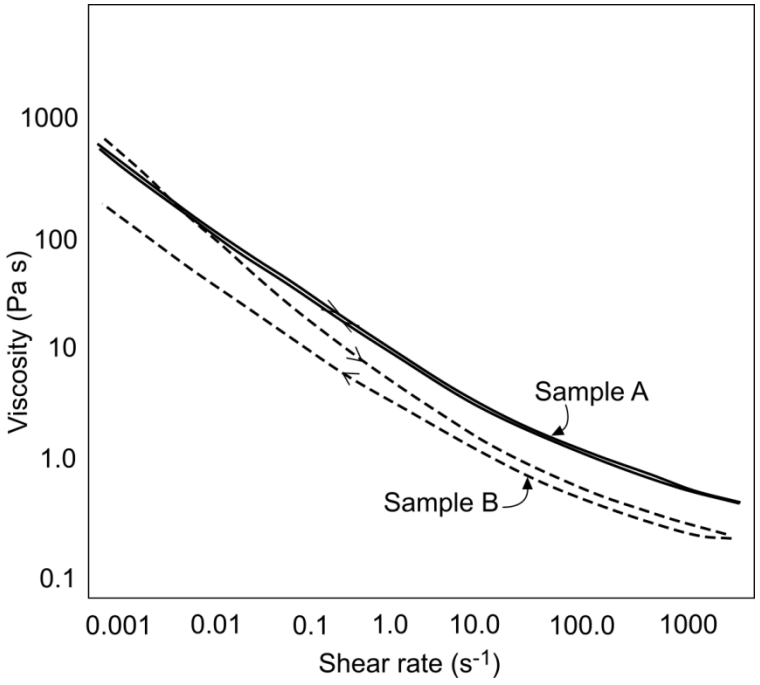


Figure 1

1.6 Figure 1 shows the flow curves for two brands of tomato sauce (Sample A & Sample B). Both samples have almost the same value of yield stress.
The following statements are true for sample A and sample B except:

A. Sample A shows pseudoplastic flow behaviour
B. Sample B show thixotropic flow behaviour
C. Sample A is expected to be readily pourable from the bottle compared to sample B
D. Sample A will spread less on the plate than that of sample B

1.7 Which of the following foods most likely display shear thinning behaviour?

I. Concentrated fruit juice (50-60° Brix)
II. Melted chocolate
III. Dairy cream
IV. Depectinized apple juice

A. I and II
B. III and IV
C. I and III
D. I, II, and III

1.8 Which of the following foods most likely display thixotropic behaviour?

I. Concentrated orange juice (60-65° Brix)
II. Mayonnaise
III. Condensed milk
IV. Corn syrups

A. I and II
B. II
C. II and III
D. II, III, and IV

1.9 The followings are the primary parameters obtained from instrumental texture profile analysis except:

A. Hardness
B. Gumminess
C. Cohesiveness
D. Fracturability

1.10 The following parameters may be determined from an instrumental texture profile analysis of apple except:

A. Adhesiveness
B. Fracturability
C. Hardness
D. Cohesiveness

1.11 Figure 2 shows differences in product properties with regard to fracturability/brittleness and hardness. Rank each sample with regard to their brittleness (most brittle to least brittle).

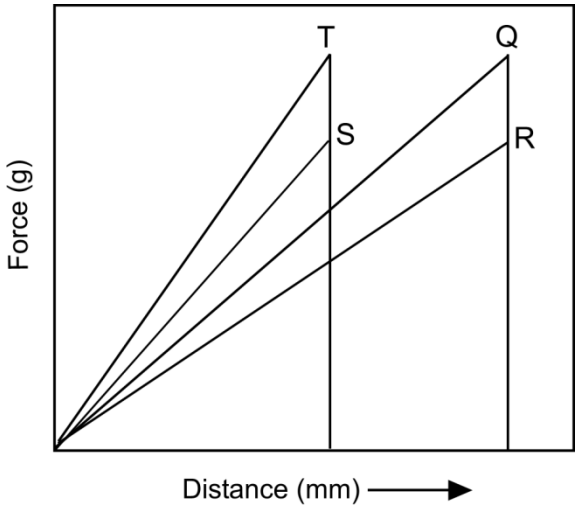


Figure 2

A. T, Q, S, R
B. S, R, T, Q
C. S, T, R, Q
D. T=Q, S=R

1.12 Rank each sample in Figure 2 with respect to their hardness (highest hardness to lowest hardness).

A. T, Q, S, R
B. T=Q, S=R
C. T, S, Q, R
D. Q, T, R, S

1.13 Which of the following foods is not a water/oil emulsion?

A. Mayonnaise
B. Margarine
C. Butter
D. Cheese

1.14 Which of the following foods is not an example of foam?
A. Ice cream
B. Mayonnaise
C. Cake batter
D. Marshmallow

1.15 The stability of an emulsion is controlled by
I. interfacial surface forces
II. size of the disperse phase droplets
III. viscosity of the continuous phase
IV. density difference between the two phases.

A. I and II
B. II and III
C. I, II, and IV
D. I, II, III, and IV

1.16 Hydrocolloids such as guar gum stabilized emulsion by
I. matching the density if of the oil and aqueous phase
II. increasing the viscosity of the continuous (aqueous) phase
III. partitioning into the o/w interface as a physical barrier to coalescence
IV. modifying the ionic strength

A. I, II, and III
B. I and II
C. II and III
D. I and IV

1.17 The rate of creaming can be lowered by:
I. reducing the droplet size
II. increasing the viscosity of the medium
III. matching the density of the oil and aqueous phase
IV. increasing the volume fraction ($\phi > 0.74$)

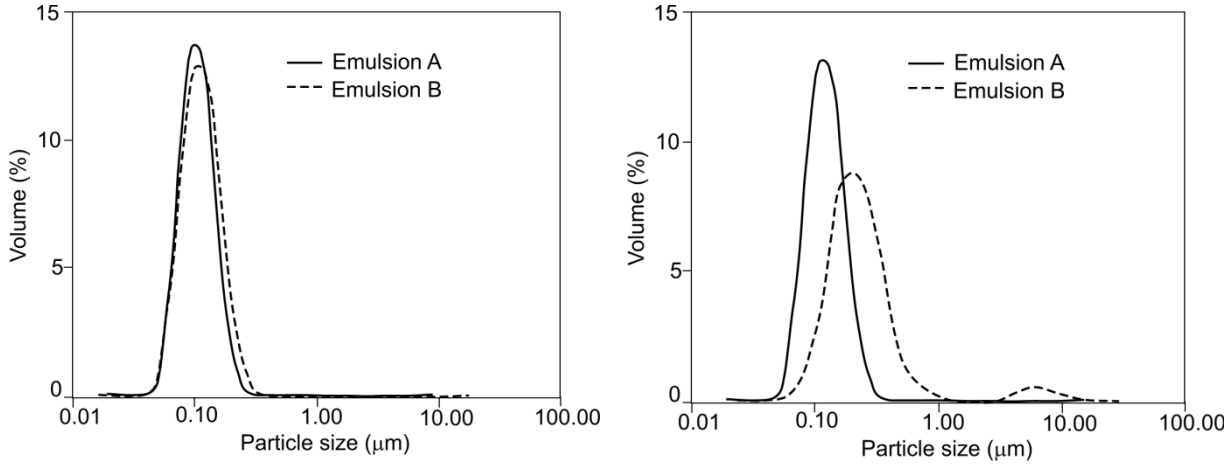
A. I, II, and III
B. I and II
C. II and III
D. I, II, III, and IV

1.18 Figure 3 shows the droplet size distribution for emulsion A and emulsion B. Both emulsions have a similar composition but emulsion A contains emulsifier A and emulsion B contains emulsifier B. Figure 3(a) shows the droplet size distribution for freshly prepared emulsion whereas Figure 3(b) after 3 days storage at ambient temperature.

Which of the following statements are true?

I. The freshly prepared emulsions have almost similar polydispersity
II. Emulsion B exhibited higher polydispersity after 3 days storage
III. Emulsifier A is more effective than emulsifier B to stabilize the emulsions
IV. Some droplets in emulsion B have flocculated or coalesced

A. I and II
B. II and III
C. II, and IV
D. I, II, III, and IV



(a) (b)

Figure 3

1.19 Which of the following statements are true for electrostatically protein-stabilized emulsion?

I. They are particularly sensitive to the ionic strength
II. They are particularly sensitive to the pH
III. They are particularly stable at pH near the pI
IV. They are least stable when the volume fraction $\phi > 0.5$

A. I and II
B. I, II, and III
C. II and III
D. I, II, III, and IV

1.20 The followings are mechanisms for foam destabilization except:

A. Drainage
B. Phase inversion
C. Coalescence
D. Disproportionation

1.21 Which of the following processes require careful control to produce numerous small crystals?

A. Fractionation of fat
B. Refining of sugars
C. Tempering of chocolate
D. Freeze concentration

1.22 Which of the following processes require careful control to produce fewer but larger crystals?

I. Fractionation of fat
II. Refining of sugars
III. Freeze concentration
IV. Tempering of chocolate

A. I and II
B. II and III
C. I, II, and III
D. II and IV

1.23 Which of the following statements about polymorphism is not true?

A. Different crystal polymorphs exhibit different melting points
B. The least stable polymorph has the lowest density
C. Lipids exhibit monotropic polymorphism
D. Milk fat and palm oil can crystallized into the β and β' forms

1.24 The followings are the factors influencing nucleation rate from a melt except:
A. Temperature
B. Supersaturation
C. Viscosity
D. Agitation rate

1.25 Which of the followings are associated with transition from amorphous glassy state to amorphous rubbery state?
I. Dry powders become sticky/lumpy
II. Crispy biscuits become soft
III. The process of making cotton candy from sucrose
IV. Bread staling during storage at ambient (30°C) temperature

A. I and II
B. II and IV
C. III, and IV
D. I, II, III, and IV

BAHAGIAN A (Wajib)
Bahagian ini mengandungi 25 soalan. Jawab SEMUA soalan di dalam borang OMR. Soalan Bahagian A akan dipungut bersama jawapan OMR selepas 1 jam peperiksaan bermula.

1.1 Viskometer kapilari kaca tidak sesuai untuk sampel berikut:

A. Jus oren
B. Jus epal jernih
C. Madu cair
D. Minuman barli

1.2 Yang mana antara berikut tidak benar bagi viskometer kapilari kaca?

I. Viskometer ini hanya sesuai bagi menentukan viskositi bendalir Newtonian
II. Viskometer ini boleh digunakan bagi menentukan viskositi bendalir bukan Newtonian
III. Viskometer ini hanya sesuai bagi menentukan viskositi bendalir yang bebas daripada pepejal terampai
IV. Viskometer ini boleh digunakan bagi menentukan viskositi cecair yang keruh

A. II dan IV
B. II
C. I dan III
D. II dan III

1.3 Yang mana antara alat-alat berikut yang memberi bacaan viskositi dalam unit asas (Pa s)?

A. Viskometer Brookfield
B. Brabender Amylograph
C. Viskometer Falling Ball
D. Konsistometer Bostwick

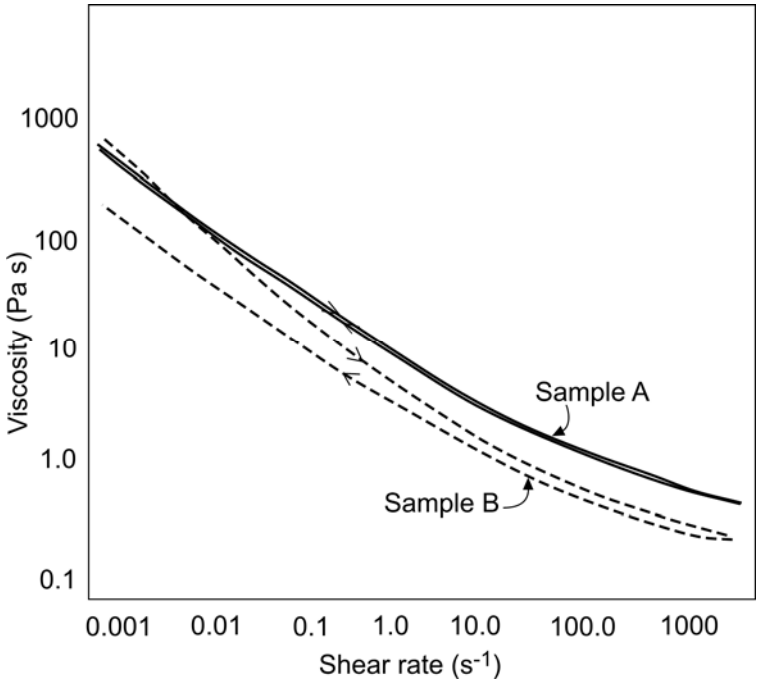
1.4 Yang mana antara model-model reologi berikut sesuai untuk menyesuaikan data bagi bendalir penipisan ricih tanpa tegasan yil?

A. Casson
B. Herschel-Bulkley
C. Power Law
D. Cross

1.5 Viskositi bendalir Newtonian boleh dipengaruhi oleh:

I. Kadar ricih
II. Sejarah ricih sebelumnya
III. Suhu
IV. Kepekatan

A. I dan III
B. II, III, dan IV
C. III dan IV
D. II dan IV



Rajah 1

1.6 Rajah 1 menunjukkan kurva alir bagi dua jenama sos tomato (sampel A dan sampel B). Kedua-dua sampel mempunyai nilai tegasan yil yang hampir sama. Kenyataan berikut adalah benar bagi sampel A dan sampel B kecuali:

A. Sampel A menunjukkan kelakuan alir pseudoplastik
B. Sampel A menunjukkan kelakuan alir tiksotropik
C. Sampel A dijangka lebih mudah untuk dituangkan dari botol berbanding sampel B
D. Sampel A dijangka kurang tersebar di atas pinggan berbanding sampel B

1.7 Yang mana antara makanan berikut kemungkinan besar menunjukkan kelakuan alir penipisan ricih?

I. Pekatan jus buah-buahan (50-60 °Brix)
II. Leburan coklat
III. Krim tenusu
IV. Jus epal ternyahpektin

A. I dan II
B. III dan IV
C. I dan III
D. I, II, dan III

1.8. Yang mana antara makanan berikut kemungkinan besar menunjukkan kelakuan alir tiksotropik?

I. Pekatan jus oren (60-65 °Brix)
II. Mayonnaise
III. Susu pekat
IV. Sirap jagung

A. I dan II
B. II
C. II dan III
D. II, III, dan IV

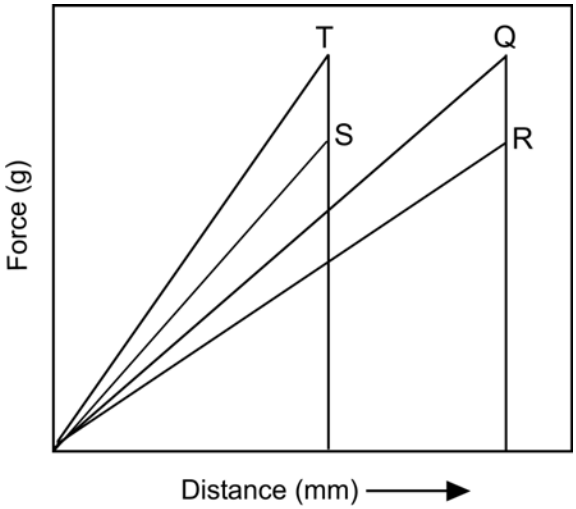
1.9 Berikut adalah parameter-parameter <u>primer</u> yang diperolehi daripada analisis profil tekstur menggunakan peralatan kecuali:

A. Hardness
B. Gumminess
C. Cohesiveness
D. Fracturability

1.10 Parameter-parameter berikut boleh ditentukan daripada analisis profil tekstur epal menggunakan peralatan kecuali:

A. Adhesiveness
B. Fracturability
C. Hardness
D. Cohesiveness

1.11 Rajah 2 menunjukkan perbezaan ciri-ciri produk daripada segi kebolehrekahan/ kerapuhan dan kekerasan. Aturkan setiap sampel mengikut ciri kebolehrekahan/ kerapuhan (paling rapuh ke paling kurang rapuh).



Rajah 2

A. T, Q, S, R
B. S, R, T, Q
C. S, T, R, Q
D. T=Q, S=R

1.12 Aturkan setiap sampel dalam Rajah 2 mengikut ciri kekerasan (paling keras ke paling kurang keras).

A. T, Q, S, R
B. T=Q, S=R
C. T, S, Q, R
D. Q, T, R, S

1.13 Yang mana antara makanan berikut bukan emulsi air/minyak?

A. Mayonnaise
B. Marjerin
C. Mentega
D. Keju

1.14 Yang mana antara makanan berikut bukan merupakan contoh busa?

A. Ais krim
B. Mayonnaise
C. Cake batter
D. Marshmallow

1.15 Kestabilan suatu emulsi dipengaruhi oleh:

I. Daya antaramuka permukaan
II. Saiz droplet fasa terserak
III. Kelikatan fasa selanjar
IV. Perbezaan ketumpatan antara dua fasa

A. I dan II
B. II dan III
C. I, II, dan IV
D. I, II, III, dan IV

1.16 Hidrokoloid seperti gam guar menstabilkan emulsi dengan cara:

I. memadankan ketumpatan fasa minyak dan fasa akues
II. meningkatkan viskositi fasa selanjar (akues)
III. Mempartisi antara antaramuka o/w sebagai halangan fizikal terhadap coalescence
IV. Mengubahsuai kekuatan ionik

A. I, II, dan III
B. I dan II
C. II dan III
D. I dan IV

1.17 Kadar penkriman boleh diperlahankan dengan:

I. mengurangkan saiz droplet
II. meningkatkan viskositi medium
III. memadankan ketumpatan fasa minyak dan fasa akues
IV. meningkatkan fraksi isipadu ($\phi > 0.74$)

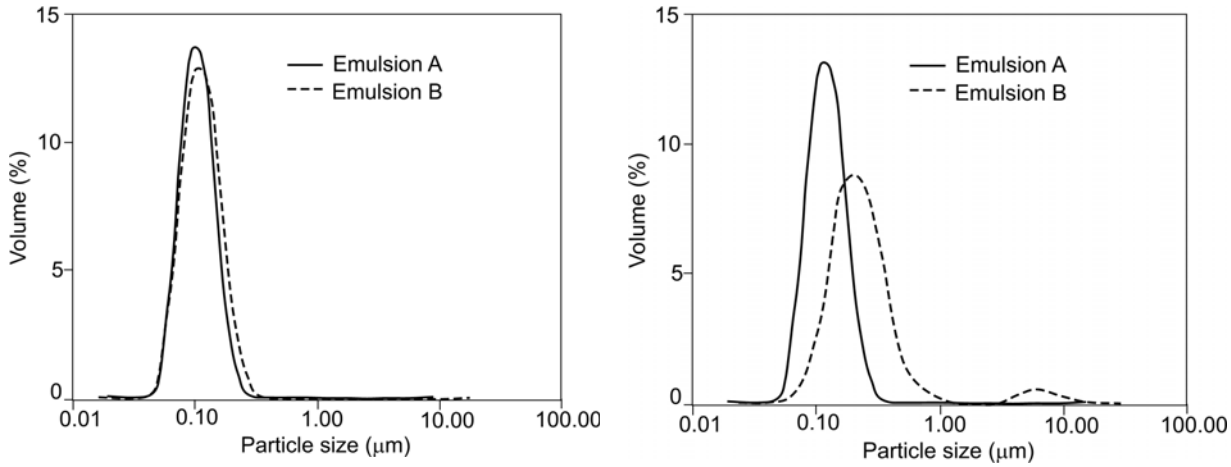
A. I, II, dan III
B. I dan II
C. II dan III
D. I, II, III, dan IV

1.18 Rajah 3 menunjukkan taburan saiz droplet untuk emulsi A dan emulsi B. Kedua-dua emulsi mempunyai komposisi yang sama tetapi emulsi A mengandungi pengemulsi A dan emulsi B mengandungi pengemulsi B. Rajah 3(a) menunjukkan taburan saiz droplet bagi emulsi yang baru disediakan manakala Rajah 3(b) selepas 3 hari penstoran pada suhu ambien.

Yang mana antara kenyataan berikut adalah benar?

I. Emulsi yang baru disediakan mempunyai polisebaran yang hampir sama
II. Emulsi B menunjukkan polisebaran yang lebih tinggi selepas 3 hari penstoran
III. Pengemulsi A adalah lebih berkesan daripada pengemulsi B untuk menstabilkan emulsi
IV. Sesetengah droplet dalam emulsi B telah membentuk flok atau coalesced

A. I dan II
B. II dan III
C. II, dan IV
D. I, II, III, dan IV



(a) *(b)*

Rajah 3

1.19 Yang mana antara kenyataan berikut benar bagi emulsi yang distabilkan oleh protein secara elektrostatik?

I. Emulsi ini terutamanya sensitif terhadap kekuatan ionik
II. Emulsi ini terutamanya sensitif terhadap pH
III. Emulsi ini terutamanya stabil pada pH berhampiran pI
IV. Emulsi ini paling kurang stabil apabila isipadu fraksi $\phi > 0.5$

A. I dan II
B. I, II, dan III
C. II dan III
D. I, II, III, dan IV

1.20 Berikut adalah mekanisme bagi penyahstabilan busa kecuali:

A. Drainage
B. Phase inversion
C. Coalescence
D. Disproportionation

1.21 Yang mana antara proses-proses berikut yang memerlukan kawalan yang teliti bagi menghasilkan bilangan hablur halus yang banyak?

A. Fraksinasi lemak
B. Penceriaan gula
C. Proses tempering coklat
D. Pemekatan sejukbeku

1.22 Yang mana antara proses-proses berikut yang memerlukan kawalan yang teliti bagi menghasilkan bilangan hablur kasar dalam jumlah yang sedikit?

I. Fraksinasi lemak
II. Penceriaan gula
III. Pemekatan sejukbeku
IV. Proses tempering coklat

A. I dan II
B. II dan III
C. I, II, dan III
D. II dan IV

1.23 Yang mana antara kenyataan berikut mengenai polimorfisme tidak benar?

A. Polimorf hablur yang berlainan mempunyai takat lebur yang berbeza
B. Polimorf yang paling kurang stabil mempunyai ketumpatan yang paling rendah
C. Lipid menunjukkan polimorfisme monotropik
D. Lemak susu dan minyak sawit boleh menghablur kepada bentuk β and β'

1.24 Berikut adalah faktor-faktor yang mempengaruhi kadar nukelasi daripada suatu leburan kecuali:

A. Suhu
B. Penepuan lampau
C. Viskositi
D. Kadar agitasi

1.25 Yang mana antara berikut berkait dengan peralihan daripada keadaan amorfus berkaca kepada keadaan amorfus bergetah?

I. Serbuk kering menjadi melekit dan bergumpal
II. Biskut rangup menjadi lemau (lembut)
III. Proses membuat cotton candy daripada sukrosa
IV. Penghapakan roti semasa penstoran pada suhu ambien (30℃)

A. I dan II
B. II dan IV
C. III, dan IV
D. I, II, III, dan IV

SECTION B
Answer any three (3) questions.

2. Answer all of the following questions regarding flow behaviour of liquid foods.

(a) Is it always necessary to determine a flow curve (also sometimes known as 'multipoint measurement'), or is it just sufficient to determine a 'single point' viscosity, i.e., determine the viscosity at one shear rate only?

(5 marks)

(b) By giving appropriate examples, explain why we have to choose an appropriate value of shear rate to determine the viscosity of a fluid.

(5 marks)

(c) Honey appears very viscous but it displays Newtonian flow behaviour. Likewise, filtered fruit juices display Newtonian flow behaviour whereas concentrated fruit juices display non Newtonian behaviour. Why?

(5 marks)

(d) The presence of yield stress in some foods is sometimes (a) desirable and sometimes (b) undesirable. Explain by giving appropriate examples.

(5 marks)

(e) The above product is a type of jelly product and it shows the nata de coco and fruit beads are suspended in the jelly. Explain the rheological principles involved, given the fact that the product actually can be sipped using a straw (so it is not a firm gel).

(5 marks)

3. Answer all of the following questions regarding food crystallization.

(a) List three (3) components that can form crystalline phase in food systems.

(3 marks)

(b) Briefly describe the arrangement of molecules in crystalline and amorphous materials.

(3 marks)

(c) What is the thermodynamic driving force for both nucleation and crystal growth in the case of (i) crystallization from a solution (e.g., sugar solution) and (ii) crystallization from a melt?

(2 marks)

(d) Give one (1) example of food product whereby crystallization is induced from a (i) solution and (ii) melt.

(2 marks)

(e) Briefly explain the meaning of metastable zone and its significance in crystallization process.

(5 marks)

(f) Briefly explain the meaning of contact secondary nucleation.

(2 marks)

(g) Briefly explain why secondary nucleation is usually undesirable during the crystallization of sucrose (sugar refining process).

(2 marks)

(h) Give two (2) reasons why the addition of hydrocolloid such as carrageenan in ice cream mix will reduce the rate of nucleation.

(2 marks)

(i) Briefly explain the significance of polymorphism in chocolate.

(2 marks)

(j) Give two (2) examples of processes where fewer but larger crystals are desired with proper size distribution for efficient separation.

(2 marks)

4. Explain how each of the following factors affect emulsion stability.

   (a) Droplet size
   (b) Density
   (c) pH and ionic strength
   (d) Emulsifiers and stabilizers

   (25 marks)

5. Answer all of the following questions regarding the glassy state in foods.

   (a) List three (3) characteristics of a glassy food material.

   (3 marks)

   (b) List three (3) characteristics of a rubbery food material.

   (3 marks)

   (c) By using appropriate examples, briefly explain the importance of glass transition temperature in food quality and stability.

   (6 marks)

   (d) Describe how an amorphous food product (such as hard candy) can be formed.

   (8 marks)

   (e) What is T_g'? Explain why T_g' is the most ideal storage temperature for storage of frozen food <u>but</u> economically not feasible/practical (limit your answer in the space provided).

   (5 marks)

BAHAGIAN B
Jawab mana-mana TIGA (3) soalan.

2. Jawab semua soalan berikut mengenai kelakuan alir makanan cecair.

(a) Adakah semestinya penentuan kelok aliran (juga dikenali sebagai "pengukuran pelbagai titik") dilakukan, atau adakah hanya mencukupi untuk menentukan kelikatan pada "titik tunggal", iaitu menentukan kelikatan pada satu kadar ricih sahaja? Terangkan jawapan anda.

(5 markah)

(b) Dengan memberi contoh-contoh yang sesuai, terangkan mengapa nilai kadar ricih yang sesuai harus dipilih untuk menentukan kelikatan sesuatu cecair.

(5markah)

(c) Madu kelihatan likat tetapi menunjukkan kelakuan alir Newtonian. Begitu juga jus buah-buahan yang ditapis menunjukkan kelakuan alir Newtonian manakala pekatan jus buah-buahan menunjukkan kelakuan alir bukan Newtonian. Mengapa?

(5 markah)

(d) Kehadiran tegasan yil dalam sesetengah makanan kadangkala (i) diingini dan kadangkala (ii) tidak diingini. Terangkan dengan memberi contoh-contoh yang sesuai.

(5 markah)

(e) Produk di atas adalah sejenis produk jeli. Ia menunjukkan nata de coco dan ketulan buah-buahan terampai di dalam jeli. Produk ini boleh disedut dengan menggunakan "straw" (jadi ia bukan suatu jel yang tegar).

(5 markah)

3. Jawab semua soalan berikut mengenai penghabluran dalam makanan.

(a) Senaraikan tiga (3) komponen yang boleh membentuk fasa hablur dalam sistem makanan.

(3 markah)

(b) Terangkan secara ringkas corak susunan molekul dalam bahan berhablur dan amorfus.

(3 markah)

(c) Apakah daya penggerak termodinamik bagi nukleasi dan pembesaran hablur dalam kes (i) penghabluran daripada suatu larutan (contohnya larutan gula) dan (ii) penghabluran daripada suatu leburan?

(2 markah)

(d) Beri satu (1) contoh produk makanan di mana penghabluran diaruhkan daripada suatu (a) larutan dan (ii) leburan.

(2 markah)

(e) Terangkan secara ringkas maksud zon mestabil dan kepentingannya dalam proses penghabluran.

(5 markah)

(f) Terangkan secara ringkas makna nukelasi sekunder sentuh.

(2 markah)

(g) Terangkan secara ringkas mengapa nukelasi sekunder lazimnya tidak diingini semasa proses penghabluran sukrosa (proses penceriaan gula).

(2 markah)

(h) Beri dua (2) sebab mengapa penambahan hidrokoloid seperti karageenan dalam ais krim akan mengurangkan kadar nukleasi.

(2 markah)

(i) Terangkan secara ringkas kepentingan polimorfisma dalam produk seperti coklat.

(2 marks)

(j) Beri dua (2) contoh pemprosesan di mana hablur bersaiz besar dalam bilangan yang sedikit dengan taburan saiz yang sesuai diingini bagi proses pemisahan yang efisien.

(2 marks)

…23/-

4. *Terangkan bagaimana setiap satu faktor berikut mempengaruhi kestabilan emulsi.*

   (a) Saiz titisan Droplet size
   (b) Ketumpatan
   (c) pH dan kekuatan ionik
   (d) Pengemulsi dan penstabil

   (25 markah)

5. *Jawab semua soalan berikut mengenai keadaan berkaca dalam makanan.*

   (a) Senaraikan tiga (3) ciri-ciri bahan makanan dalam keadaan berkaca.

   (3 markah)

   (b) Senaraikan tiga (3) ciri-ciri bahan makanan dalam keadaan bergetah.

   (3 markah)

   (c) Dengan menggunakan contoh-contoh yang sesuai, terangkan secara ringkas kepentingan suhu peralihan kaca terhadap kualiti dan kestabilan makanan.

   (6 markah)

   (d) Terangkan secara ringkas bagaiman produk makanan amorfus (seperti kandi keras) boleh terbentuk.

   (8 markah)

   (e) Apakah T_g'? Terangkan secara ringkas mengapa T_g' merupakan suhu yang paling ideal bagi penstoran makanan sejukbeku tetapi tidak praktikal/sesuai dari segi ekonomi.

   (5 markah)

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