ITP503
ANALISIS SIFAT TERMAL PANGAN

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ITP503
ANALISIS SIFAT TERMAL PANGAN

- **Konduktivitas panas**
- **Difusivitas panas**
- **Expansi panas**
- **Panas jenis**
- **Enthalpy**

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Penggunaan Model Pedugaan

Panas Jenis Pangan

Cp = f([H20], [protein], [lemak], [KH], [Abu])

Heldman (1975):

$$Cp = 4.180X^{w}_{H20} + 1.547X^{w}_{prot} + 1.672X^{w}_{Lemak} + 1.42X^{w}_{KH} + 0.836X^{w}_{Abu}$$

Choi and Okos (1986), produk dengan *n* komponen:

$$c_p = \sum(X^{w}_{i} \cdot c_{pi})$$

X^{w}_{i} = fraksi masa komponen *i* ,
c_{pi} = panas jenis komponen *i* (J/kg K).

Penggunaan Model Pedugaan

Panas Jenis kentang
Contoh:

Berapa nilai Cp kentang dengan kadar air (bb) 85%?.
Data:

c_{pwater} = 4186.*80 J/kgK*
$c_{pnonfat\ solids}$ = 837.*36 J/kgK*

Choi and Okos (1986):
$c_p = \sum(X^{w}_{i} \cdot c_{pi})$

$$c_p = \sum_{i=1}^{n} X_i^w c_{pi}$$

$$c_p = (0.85)(4186.8) + (0.15)(837.36)$$
$$= 3684.38\ \text{J/kg K}$$

Penggunaan Model Pedugaan

Panas Jenis Aple
Contoh:

Berapa nilai Cp kentang dengan kadar air (bb) 85%?.
Data:
c_{pwater} = 4186.*80 J/kgK*
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$$= 3684.38\ \text{J/kg K}$$

Penggunaan Model Pedugaan

Panas Jenis Udara = f(RH)

Riegel,1992 :

$C_{p\ \text{udara basah}} = c_{p\ \text{dry air}}(1 + 0.837RH)$

Penggunaan Model Pedugaan

Panas Jenis Pangan = f(T)

Choi and Okos (1986), Cp[=] J/kg◦C , sebagai berikut :

$cp_{H_2O} = 4081.7 - 5.3062\,T + 0.99516T^2$ (−40 → 0◦C)

$cp_{H_2O} = 4176.2 - 0.0909\,T + 5.4731 \times 10^{-3}\,T^2$ (0 →150◦C)

$cp_{KH} = 1548.8 + 1.9625\,T - 5.9399 \times 10^{-3}\,T^2$ (−40 → 50◦C)

$cp_{prot} = 2008.2 + 1.2089\,T - 1.3129 \times 10^{-3}\,T^2$ (−40 →150◦C)

$cp_{lemak} = 1984.2 + 1.4373\,T - 4.8008 \times 10^{-3}\,T^2$ (−40 → 150◦C)

$cp_{abu} = 1092.6 + 1.8896\,T - 3.6817 \times 10^{-3}\,T^2$ (−40 →150◦C)

$cp_{es} = 2062.3 + 6.0769\,T$

T [=] ◦C.

Penggunaan Model Pedugaan Vs. Hasil Pengukuran ?

Panas Jenis Udara = f(RH)

- **Umumnya, Cp: hasil pengukuran > Hasil Pendugaan**
- **? → interaksi komponen dengan air →air terikat**
- **Rahman (1993):**
  - **excess specific heat, c_{ex} →**

$$c_p = \left[\sum_{i=1}^{n} X_i^w c_{pi}\right] - c_{ex}$$

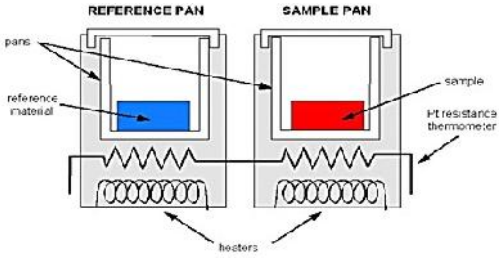
  - **Fresh seafood (Rahman, 1993) :**

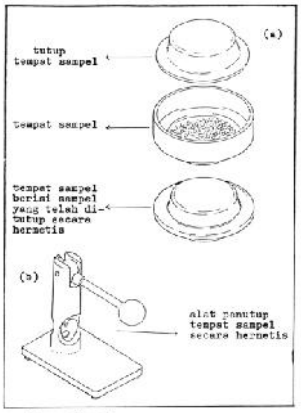
$$c_{ex} = -33.77 + 85.58\left(X_w^w\right) - 53.76\left(X_w^w\right)^2$$

Differential Scanning Calorymetry (DSC)

- **teknik untuk menganalisis perbedaan jumlah panas yang diperlukan untuk meningkatkan suhu "sampel" dan "baku" diukur sebagai fungsi suhu.**

Skema DSC

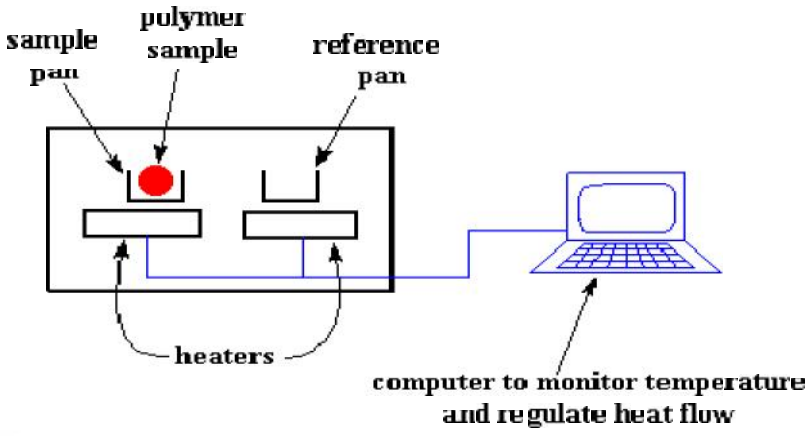




Tempat sampel (sample pan) dan alat penutup secara hermetis

Differential Scanning Calorymetry (DSC)

- **teknik untuk menganalisis perbedaan jumlah panas yang diperlukan untuk meningkatkan suhu "sampel" dan "baku" diukur sebagai fungsi suhu.**



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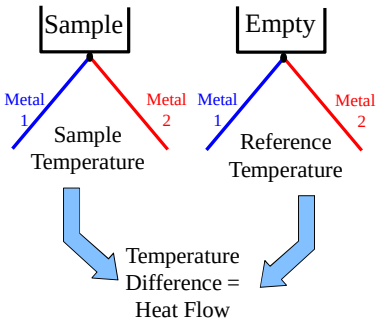
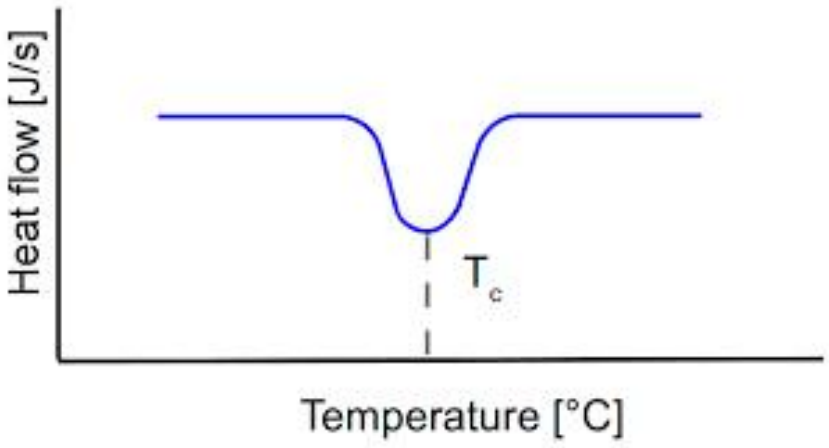
Differential Scanning Calorymetry (DSC)



•A “linear” heating profile even for isothermal methods

Differential Scanning Calorymetry (DSC)

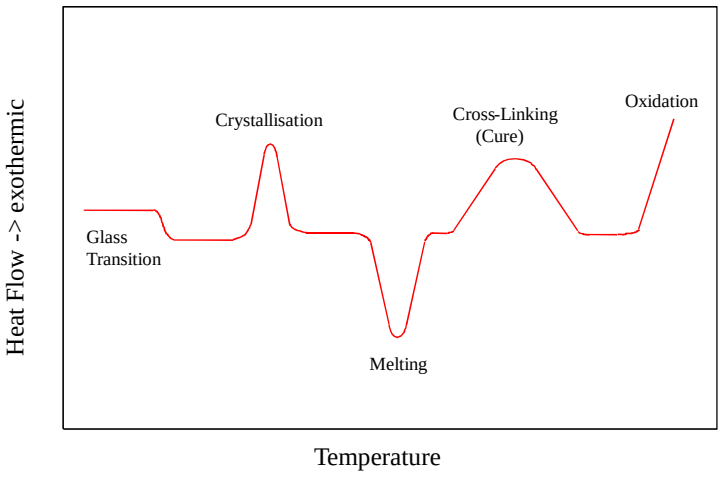
- **Tiikal Kurva DSC**



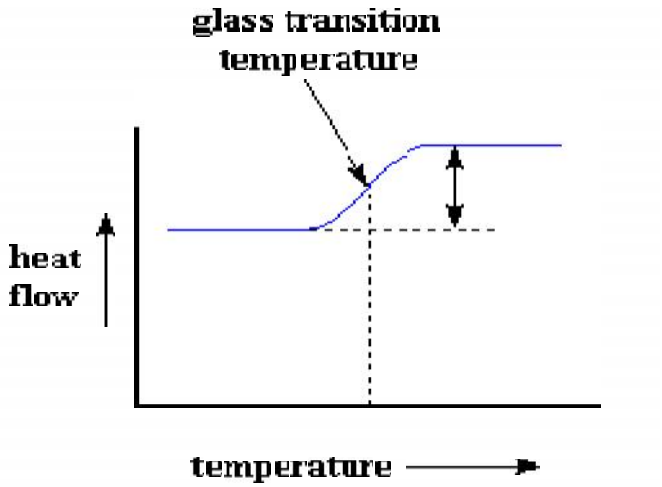
Differential Scanning Calorymetry (DSC) Analisis ?

- Glass transitions
- Melting and boiling points
- Crystallisation time and temperature
- Percent crystallinity
- Heats of fusion and reactions
- Specific heat capacity
- Oxidative/thermal stability
- Reaction kinetics
- Purity

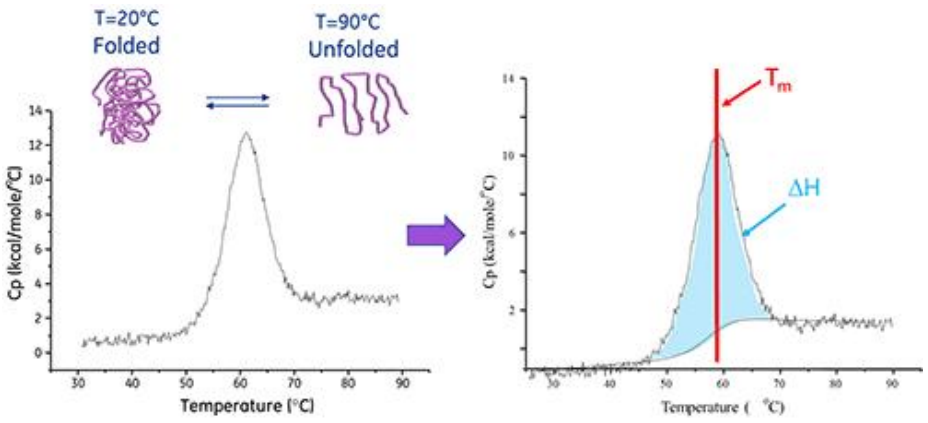
Differential Scanning Calorymetry (DSC) Analisis ?



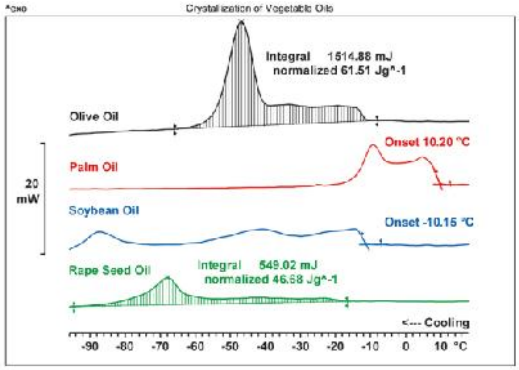
Differential Scanning Calorymetry (DSC)
Analisis ? Suhu Transisi Gelas



Differential Scanning Calorymetry (DSC)
Analisis ? Pelipatan proein (*Protein Folding-unfolding*)



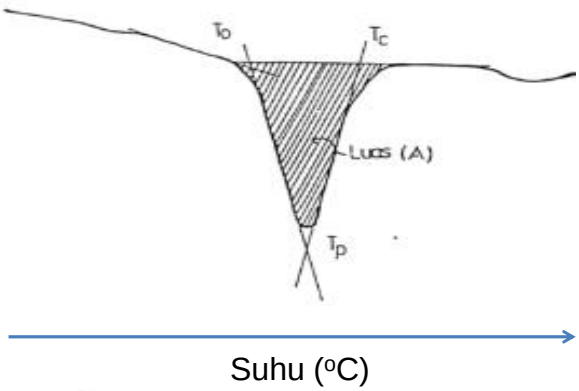
Differential Scanning Calorymetry (DSC)
Analisis ? Kristalisasi



Evaluation

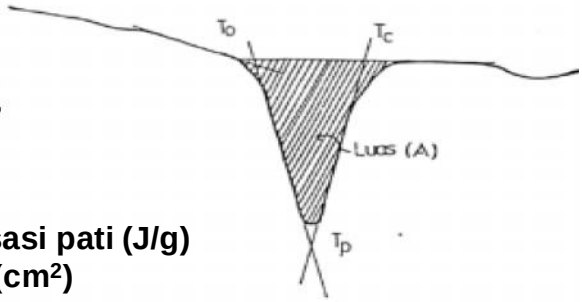
Sample	sample weight in mg	Heat of crystallization in J/g	Onset of crystallization in °C
Olive oil	24.63	61.5	-10.3
Palm oil	7.23	91.3	+10.2
Soybean oil	27.67	30.9	-10.2
Rape seed oil	11.76	46.7	-17.1

Differential Scanning Calorymetry (DSC)
Analisis ? Entalpi



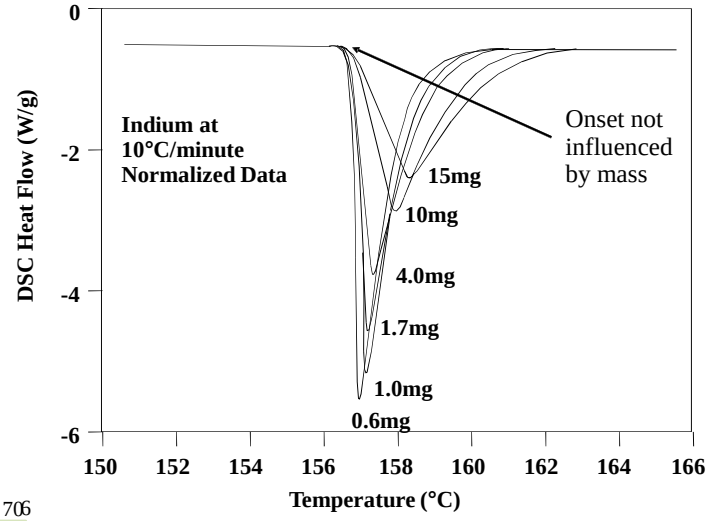
Differential Scanning Calorymetry (DSC)
Analisis ? Entalpi

$$\Delta H = \frac{60 \cdot A \cdot TB \cdot E \cdot \Delta qs}{m}$$



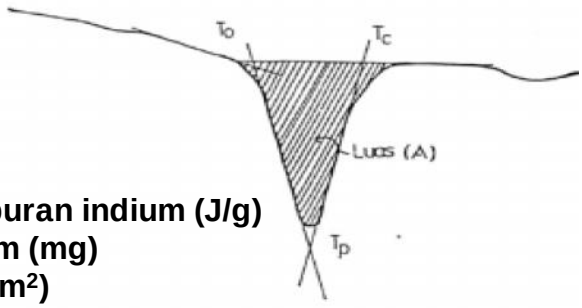
Δ = entalpi gelatinisasi pati (J/g)
A = luas area kurva (cm^2)
TB = basis waktu (menit/cm)
E = koefisien kalibrasi (mW/mV)
Δqs = skala sensitifitas (mV/cm)
m = massa sampel sagu (mg, berat kering)

Differential Scanning Calorymetry (DSC)
Analisis ? Entalpi → perlu standar→ Indium



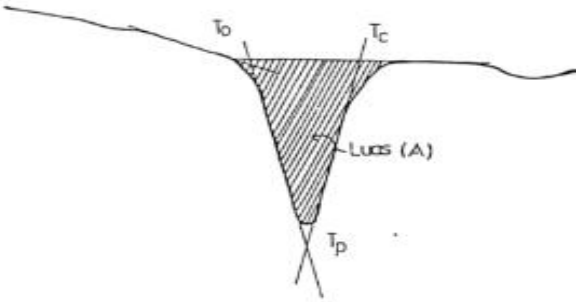
Differential Scanning Calorymetry (DSC)
Analisis ? Entalpi → perlu standar→ Indium

$$E = \frac{\Delta H \cdot m}{60 \cdot A \cdot TB \cdot \Delta qs}$$



ΔH = panas peleburan indium (J/g)
m = massa indium (mg)
A = luas kurva (cm^2)
TB = basis waktu (menit/cm)
Δ = skala sensitifitas (mV/cm)
E = koefisien kalibrasi (mW/mV)

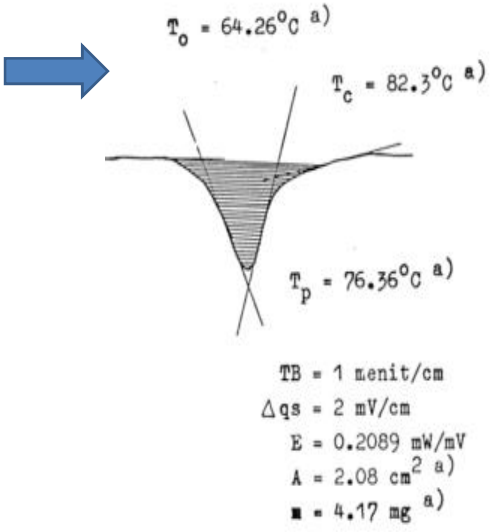
Differential Scanning Calorymetry (DSC)
Analisis ? Entalpi → perlu standar→ atau Lainnya



Substance	Indium	Tin	Lead	Zinc	Aluminum	Gold	Palladium
Symbol	In	Sn	Pb	Zn	Al	Au	Pd
Tf [°C]	156.6	231.9	327.5	419.6	660.3	1064.2	1554.0
ΔHf [J/g]	28.5	60.1	23.0	107.5	397.0	63.7	162.0
Order no	00 119 442	51 140 621	00 650 013	00 119 441	51 119 701	51 140 616	51 140 617

Differential Scanning Calorymetry (DSC) Analisis ? Kemurnian?

Termogram DSC untuk pati sagu segar. Nilai entalpi gelatinisasi pati sagu (rasio air/pati 5/1) = 12.5 J/g atau 2.99 kal/g
(Hariyadi, 1984)



Differential Scanning Calorymetry (DSC) Analisis ? Kemurnian?

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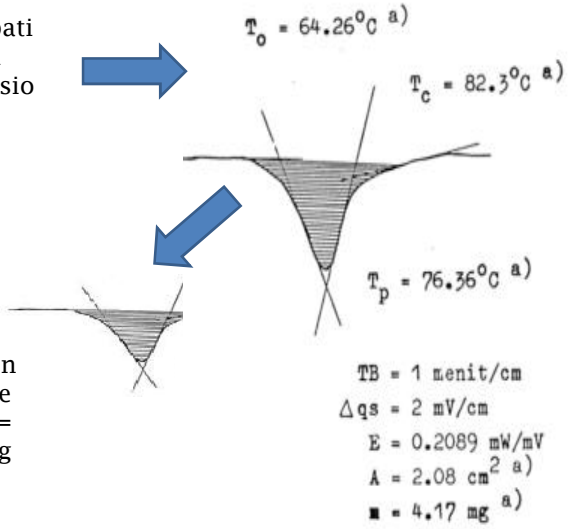

Termogram DSC untuk sampel pati sagu yang lain (dianalisis dengan metode sama; rasio air/pati 5/1) = 4.166 J/g atau 0.996 kal/g

ARTINYA?

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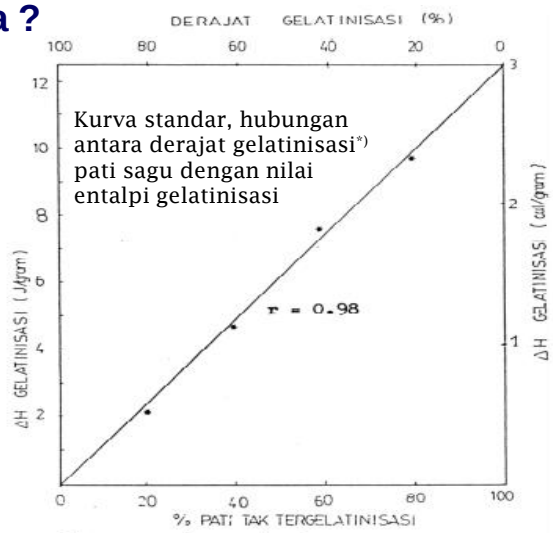
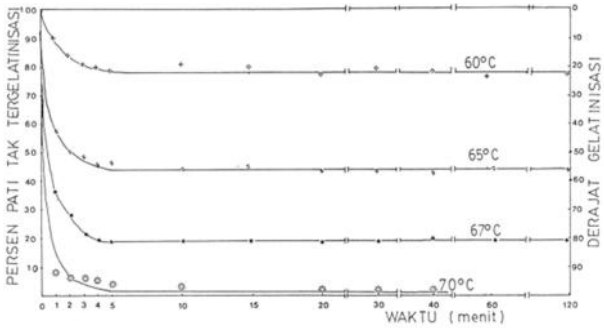
Differential Scanning Calorymetry (DSC)
Analisis ? Kinetika ?



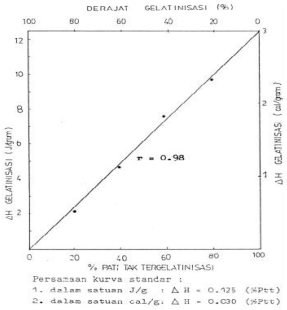
Kurva standar, hubungan antara derajat gelatinisasi*) pati sagu dengan nilai entalpi gelatinisasi

Persamaan kurva standar :
1. dalam satuan J/g : Δ H = 0.125 (%Ptt)
2. dalam satuan cal/g: Δ H = 0.030 (%Ptt)

Differential Scanning Calorymetry (DSC)
Analisis ? Kinetika ?



Derajat gelatinisasi pati sagu sebagai fungsi waktu pada berbagai suhu pemanasan



Kurva standar, hubungan antara derajat gelatinisasi*) pati sagu dengan nilai entalpi gelatinisasi

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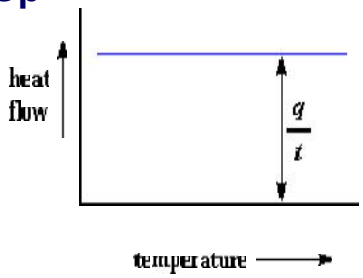
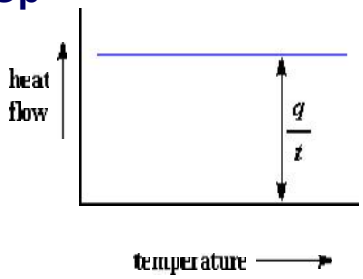
Differential Scanning Calorymetry (DSC)
Analisis ? Cp



$$\frac{\text{Heat}}{\text{time}} = \frac{q}{t} = \text{heat flow}$$

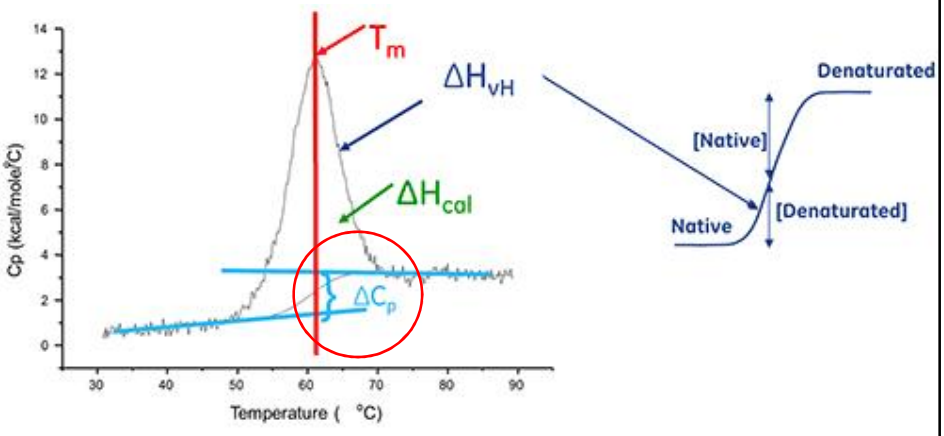
$$\frac{\text{Temperature increase}}{\text{time}} = \frac{\Delta T}{t} = \text{heating rate}$$

Differential Scanning Calorymetry (DSC)
Analisis ? Cp



$$\frac{\frac{q}{t}}{\frac{\Delta T}{t}} = \frac{q}{\Delta T} = C_p = \text{Heat capacity}$$

Differential Scanning Calorymetry (DSC)
Analisis ? Cp



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