POSSIBLE BENEFICIATION OF WASTE CHICKEN FEATHERS VIA CONVERSION INTO BIOMEDICAL APPLICATIONS

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Background of the problem

68-72%

28-32%

Meat for human consumption

Waste/by-products

- Feathers
- Meat
- Blood

8-10%

Chicken Feathers

- Feather meals for live stock
- Products for decoration
- Pillow fillers, etc.

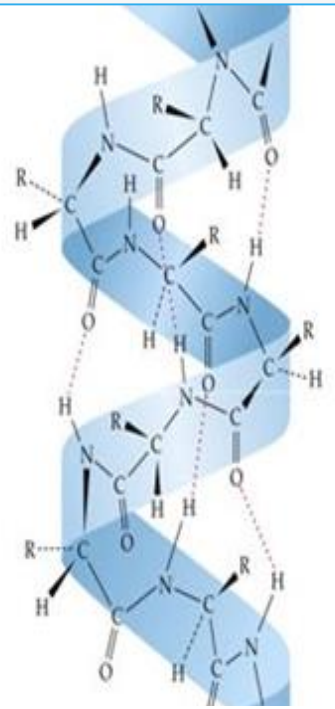
- Incineration
- Burial and land filling sites

South Africa produces 258 million kg of waste chicken feathers, on average, per annum

Chicken Feathers composition

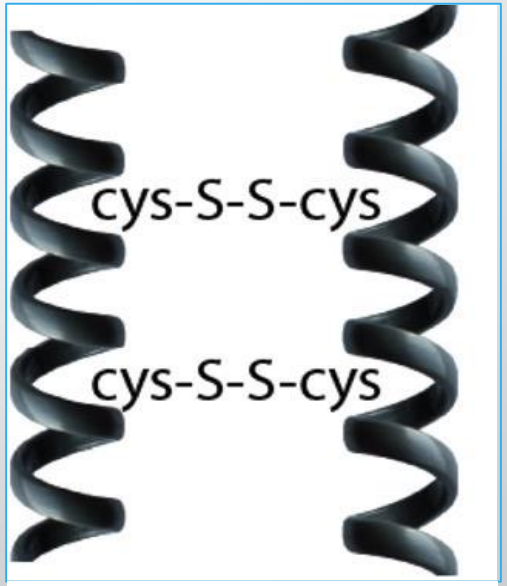
Chicken Feather

- 91%Keratin protein
- 8% Water
- 1% Lipid



α-Helix Keratin Structure

- Natural biopolymer
- Cosmetic grade price: R43-R2000/kg



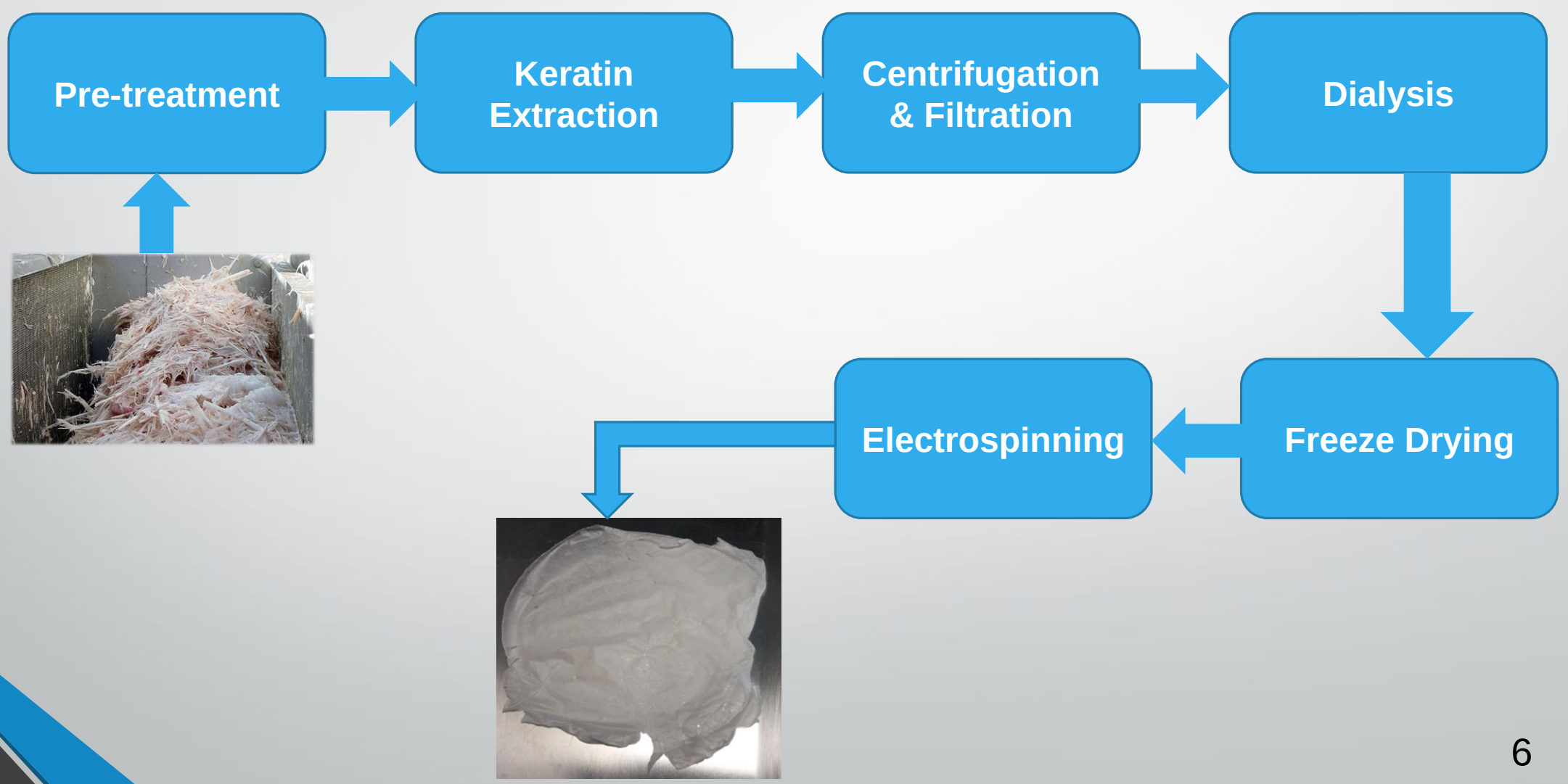
Keratin fibre

Current work:
Valorisation of waste chicken feathers

- **The aim** of the project is to valorise waste chicken feathers by converting chicken feather keratin into keratin nanofibers.

Biomedical applications of nanofibres

Methodology

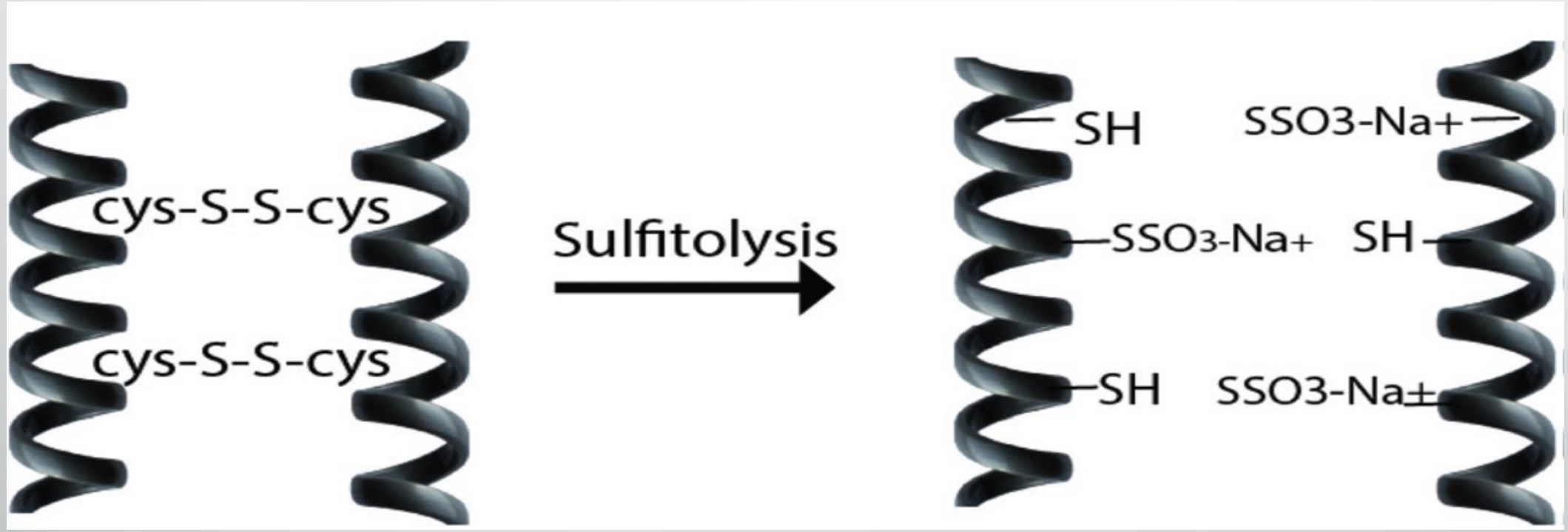


Keratin Extraction using chemicals

- The following keratin extraction by chemical methods were reviewed:
  - Shandai method (2-mercaptoethanol):
  - Sodium metabisulphite: $Na_2S_2O_5$
  - Sodium sulphide: Na_2S
  - Sodium bisulphite: $HNaSO_3$
  - Thioglycols
  - Immidazole ionic liquid

Chemical extraction method using **sodium bisulphite** was chosen for the current project due to its effectiveness in keratin extraction, cost, environmental friendliness and minimised harmfulness .

Keratin Extraction using $NaHSO_3$



Sulfitolysis of disulphide bond during keratin extraction

Optimisation of Keratin Extraction using Response Surface Method

Factor	Unit	Low value	High value
$NaHSO_3$	M	0,2	0,4
$NaC12H_{25}SO_4$	M	0	0,07
Temperature	^0C	50	90
Time	h	2	4

Urea concentration was kept constant at 1.5M

Keratin Extraction Results

Run	$NaHSO_3$(M)	$NaC_{12}H_{25}SO_4$ (M)	Temp (^{0}C)	Time(h)	Keratin Yield (%)
1	0,3	0	50	3	0,17
2	0,3	0,07	50	3	7,01
3	0,3	0,035	50	2	4,34
4	0,3	0,035	50	4	6,89
5	0,2	0,035	50	3	5,60
6	0,4	0,035	50	3	9,17
7	0,3	0,07	70	4	51,38
8	0,2	0,07	70	3	33,80
9	0,3	0,035	70	3	26,21
10	0,3	0,035	70	3	30,65
11	0,3	0	70	4	11,51
12	0,3	0,035	70	3	29,60
13	0,4	0,035	70	4	3,95

Keratin Extraction Results

Run	$NaHSO_3$(M)	$NaC_{12}H_{25}SO_4$ (M)	Temp (^{0}C)	Time(h)	Keratin Yield (%)
14	0,4	0	70	3	7,74
15	0,2	0,035	70	4	18,99
16	0,2	0	70	3	6,08
17	0,3	0,035	70	3	16,84
18	0,4	0,07	70	3	38,45
19	0,2	0,035	70	2	12,69
20	0,3	0,07	70	2	32,98
21	0,3	0,035	70	3	5,08
22	0,4	0,035	70	2	1,81
23	0,3	0	70	2	12,86
24	0,3	0,035	90	4	43,41
25	0,3	0,07	90	3	17,63
26	0,2	0,035	90	3	20,01
27	0,3	0,035	90	2	9,66
28	0,3	0	90	3	9,72
29	0,4	0,035	90	3	14,10

Keratin Extraction Results

ANOVA Table

Source	p-value
Model	0.0335
B-$NaC_{12}H_{25}SO_4$	0.7187
C-Temperature	0.0206
D-Time	0.5816
BD	0.1005
B^2	0.0307
D^2	0.0935

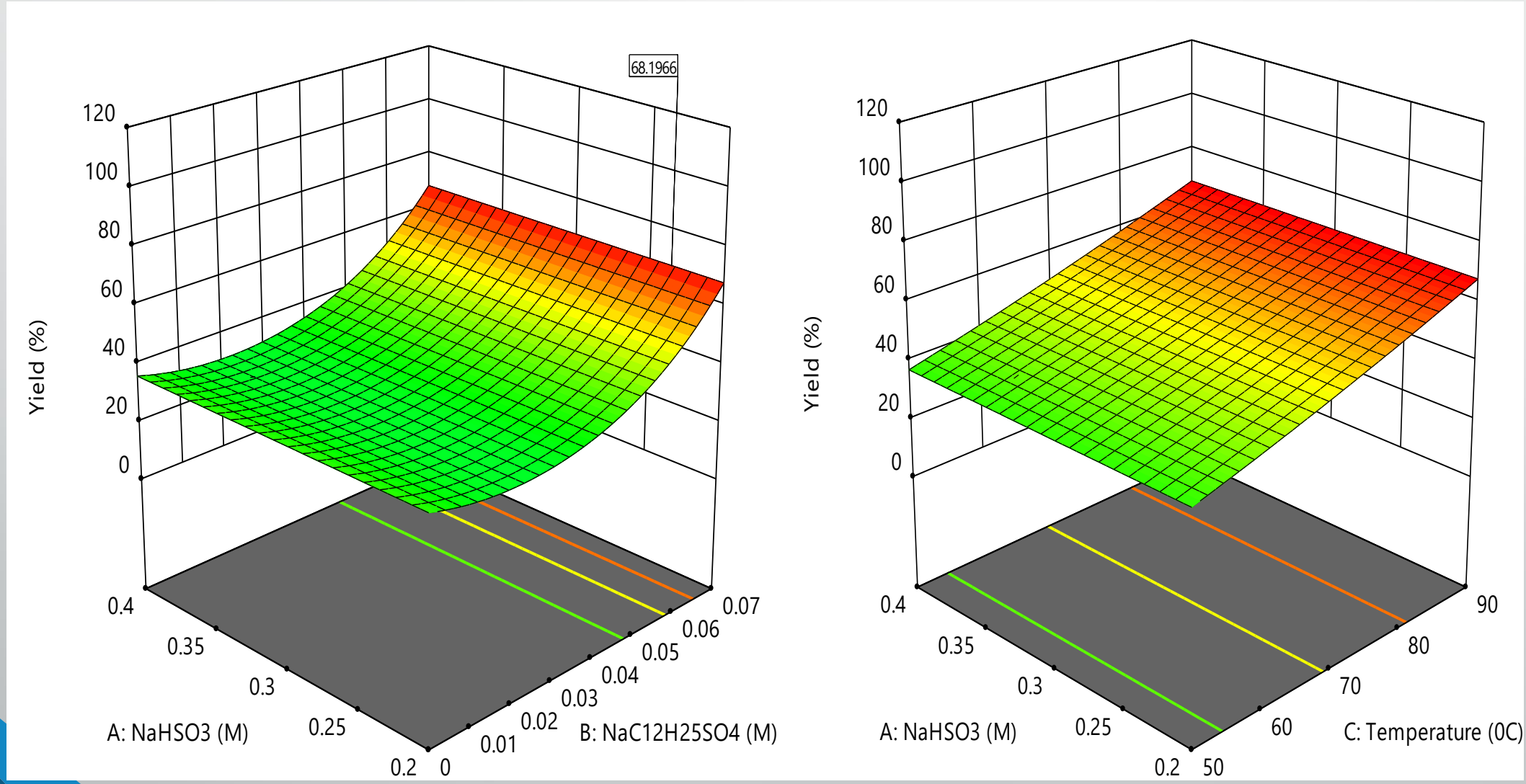
Optimised Parameters

Factor	Name	Level	Low Level	High Level
A	$NaHSO_3$	0.23	0.2	0.4
B	$NaC_{12}H_{25}SO_4$	0.07	0.00	0.07
C	Temperature	89,90	50	90
D	Time	4.00	2	4

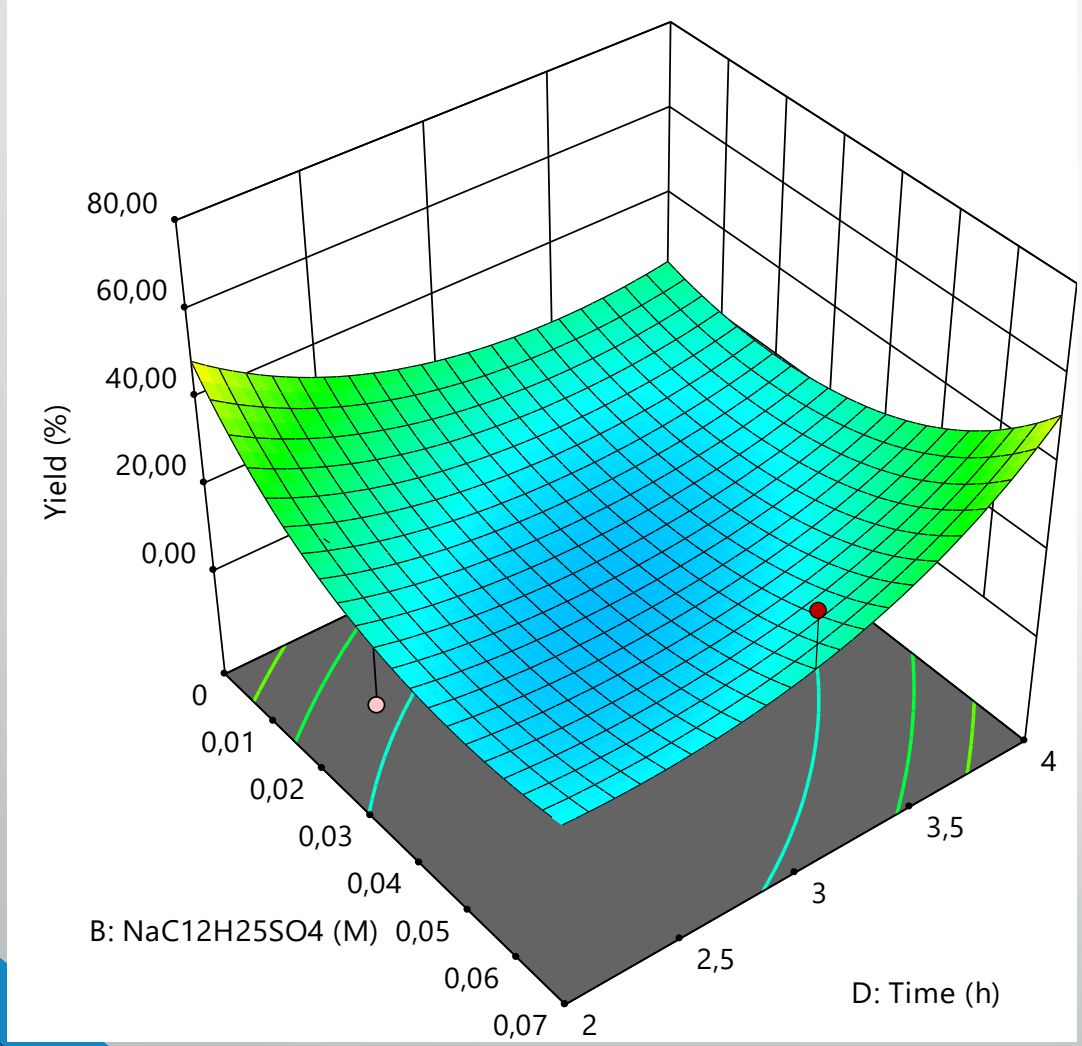
Run #7 Parameters

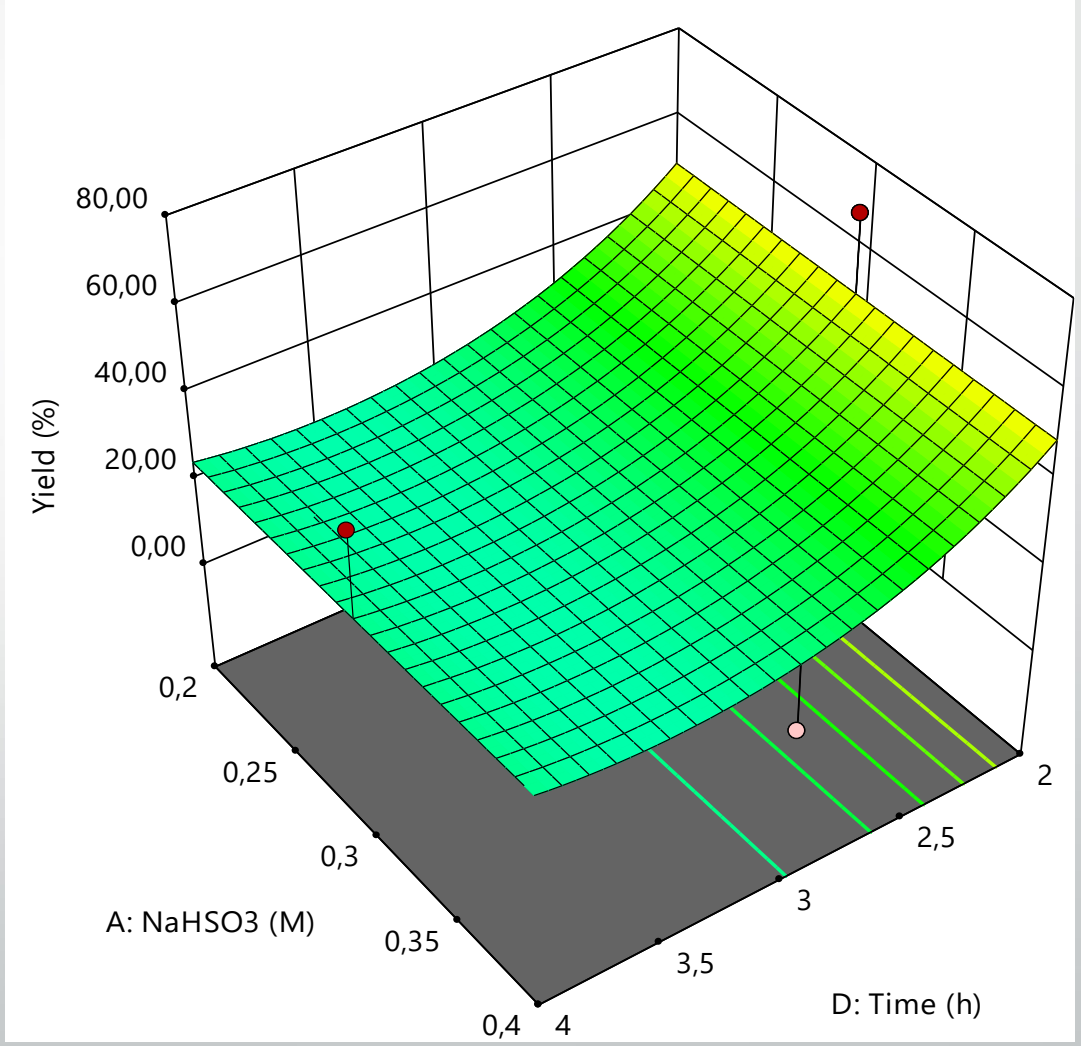
$NaHSO_3$ (M)	$NaC_{12}H_{25}SO_4$ (M)	Temp (°C)	Time (h)	Yield (%)
0,3	0,070	90	4,0	51

Keratin Extraction Results

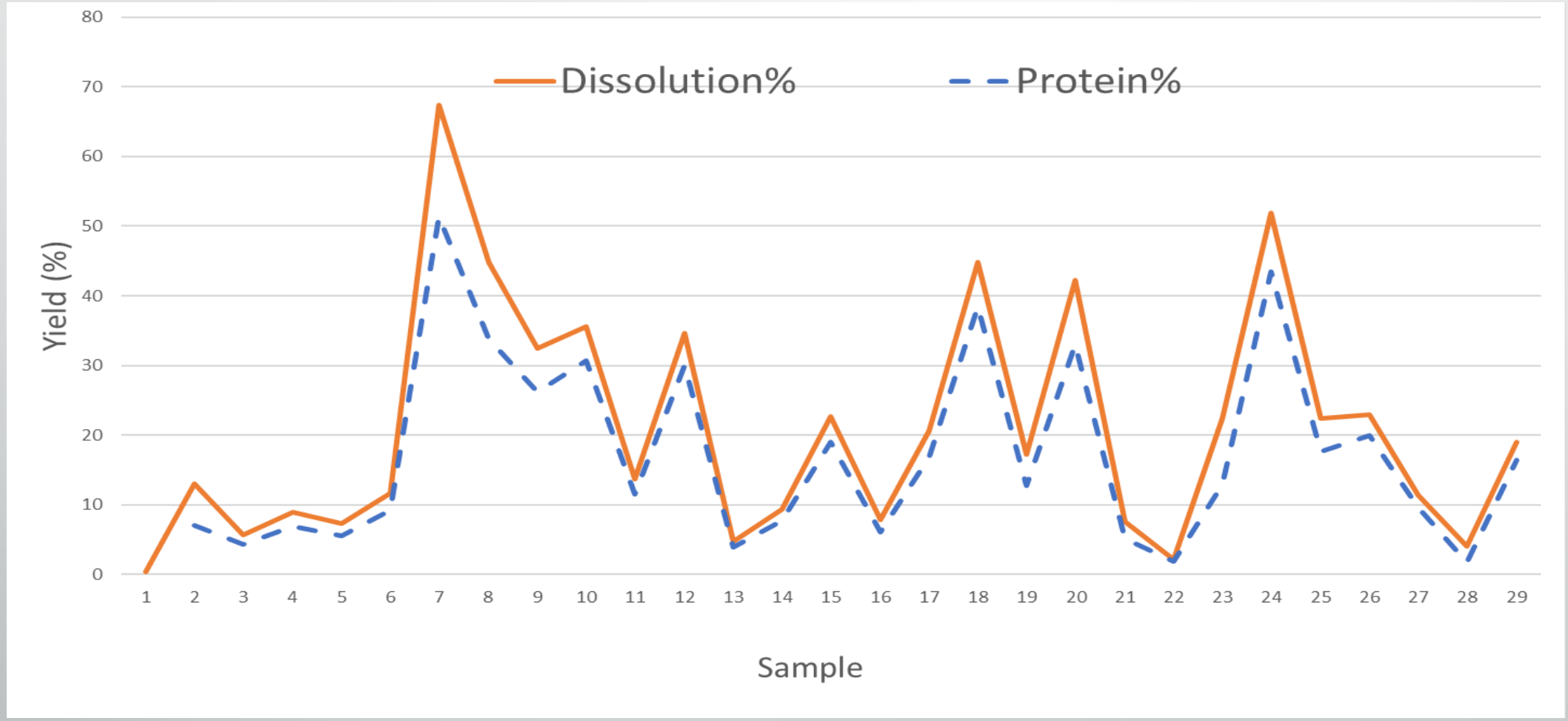


Keratin Extraction Results

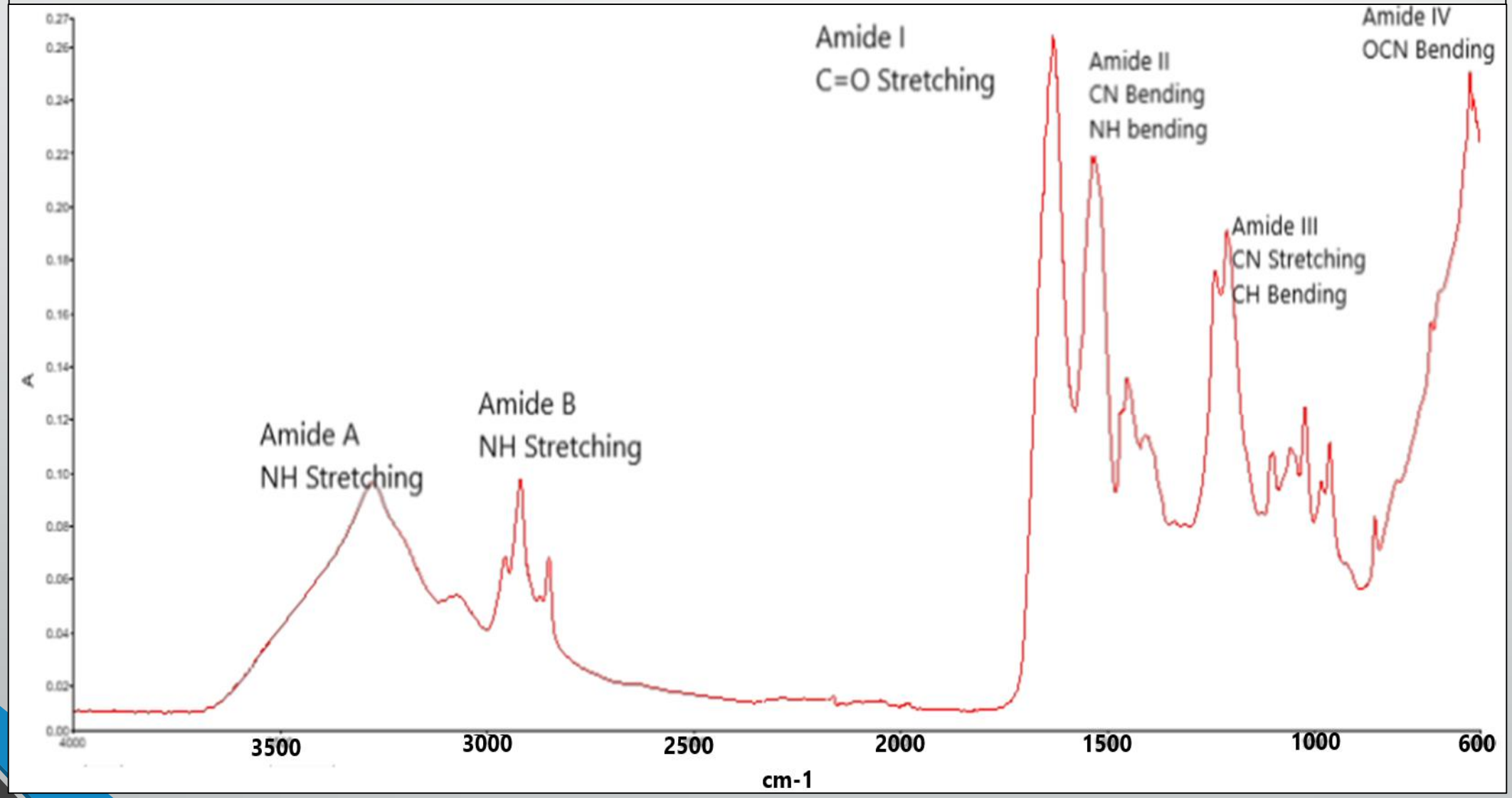




Characterisation



Characterisation

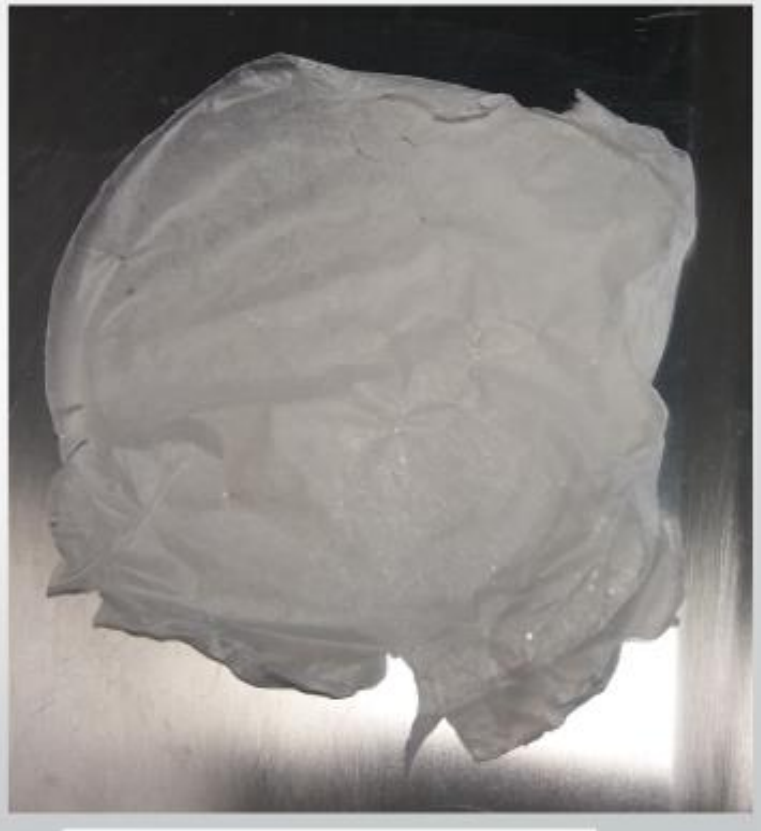


Next activity: Electrospinning of keratin

Electrospinner

Examples of electropun nanofibres

8% PVA in distilled water



10% PVA in distilled water

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Acknowledgments

Thank you for your attention