Development of a novel Green conditioning agent produced by a sustainable route from the Amazon Pracaxi Oil

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Amazonian Pracaxi Oil

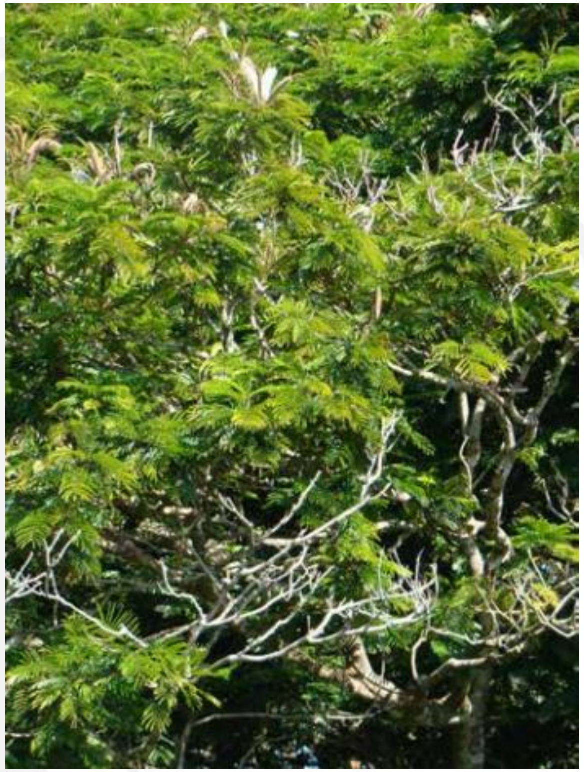
Extracted from *Pentaclethra macroloba* seeds, this oil offers powerful cosmetic benefits, both for skin and hair treatment. Due to its antioxidant activity, it is used for the treatment of hyperpigmentation and stretch marks. As consequence of its high content in behenic acid, it contributes to anti-frizz, in addition to promoting shine and softness to hair, improving combability.

It ensures fair income for local communities.

The production process is intelligent and respectful, promoting positive socio-environmental impacts.

Obtained sustainably by local producers in the Amazon rainforest, rather than through predatory methods.

Amazonian Pracaxi Oil



Supports the conservation of the Amazon, the largest biome in the world.

Improves the life quality of local families.

Employs circular economy and upcycling principles in its production model.

ECO FRIENDLY
ECO FRIENDLY

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Behenamidopropyl Dimethylamine (BAPDMA)

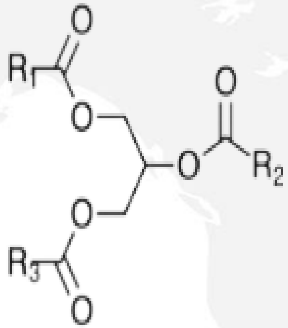
Behenic acid is used to produce the conditioning agent BAPDMA (Behenamidopropyl Dimethylamine), which has excellent characteristics:

- High performance as a conditioning agent, comparable to the best products on the market, such as BTAC;
- Compatible with anionic and amphoteric surfactants;
- Eco-friendly, unlike conventional cationic agents such as CTAC and BTAC.

However, Its production uses oils such as rapeseed (HEAR), from the *Brassica* family, which contain a high level of erucic acid (C22:1) instead of behenic acid (C22:0).

The process involves the numerous high-cost, high-risk steps:

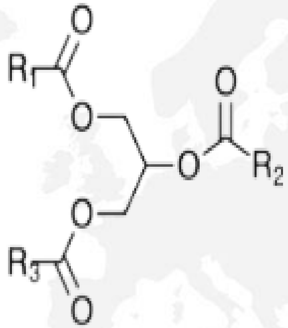
Behenamidopropyl Dimethylamine (BAPDMA)



HEAR Oil

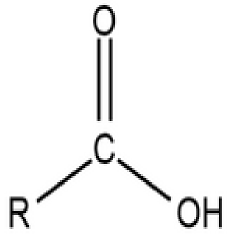
Hydrogenation

Expensive and
hazardous process



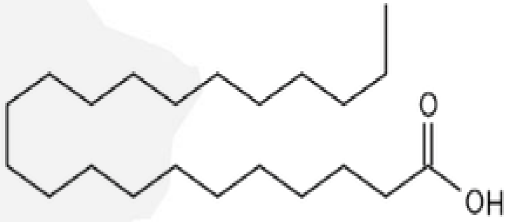
Saturated

Fat splitting
(hydrolysis)



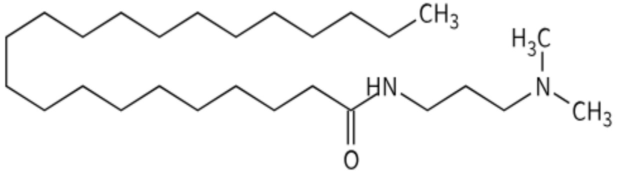
Fatty acids

Distillation



Behenic acid 22.0

Amidation

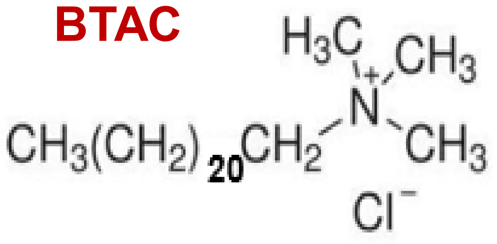


BAPDMA

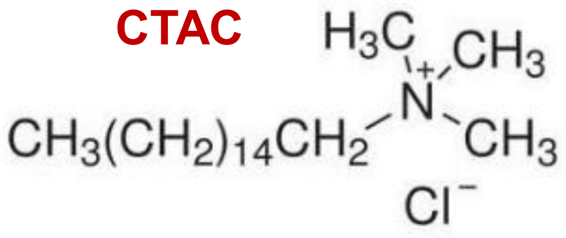
Why is BAPDMA so interesting?

Typical cationic conditioning agents

BTAC

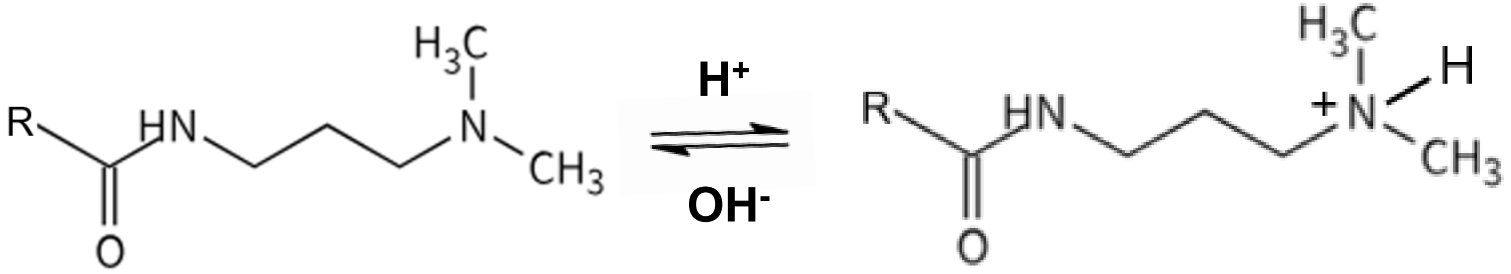


CTAC



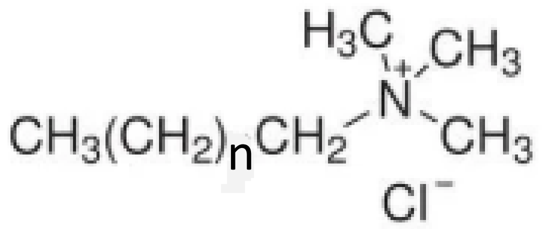
ECO-TOXIC!

Amidoamines

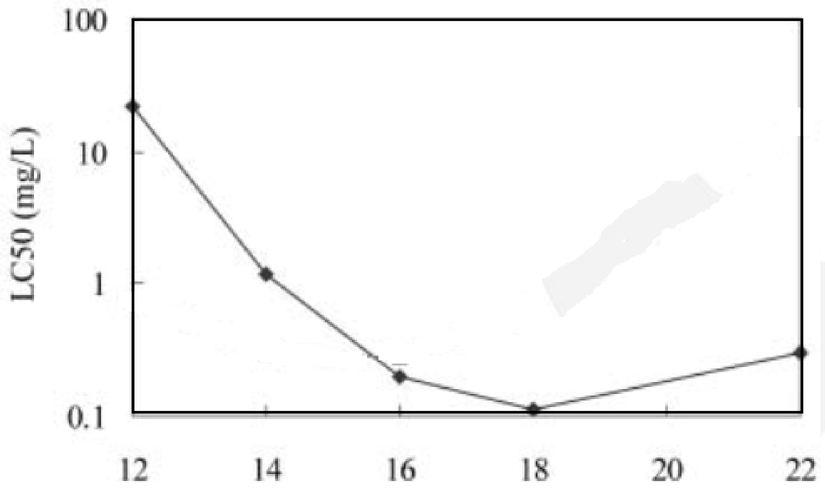


Pseudo-cationics!

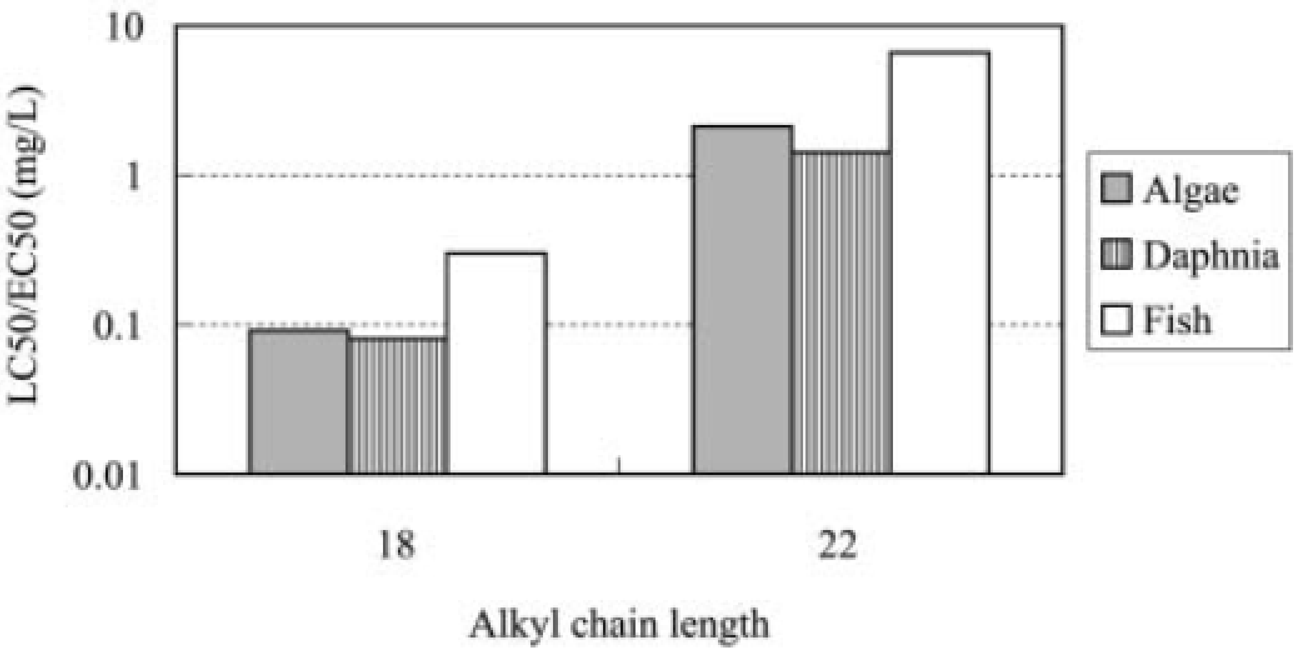
However….



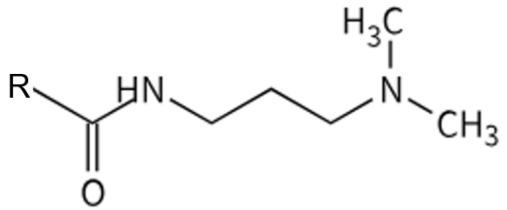
Toxicity profile of TAC to Fish



Alkyl chain length



Toxicity of SAPDMA and BAPDMA to Algae, Daphnia and Fish



SAPDMA – C18
BAPDMA – C22

J. Oleo Sci. **57**, (10) 529-538 (2008)

Project Description

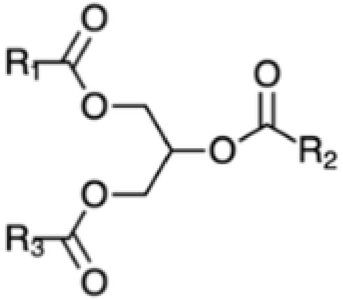
Development of a new conditioning agent: AAPDMA C22-C24, that essentially consists in a mixture of the alkylamidopropyl dimethylamines BAPDMA (C22.0) and LigAPDMA (C24.0), produced from Pracaxi Oil through a new sustainable route, developed by our research group.

Pracaxi Oil in terms of fatty acids

Fatty acid	*%*
Caproic (C6.0)	*0.19*
Palmitic (C16.0)	*1.44*
Stearic (C18.0)	*2.54*
Oleic (C18.1)	*53.27*
Linoleic (C18.2)	*12.16*
Linolenic (C18.3)	*0.11*
Behenic (C22.0)	*16.47*
Lignoceric (C24.0)	*11.57*
Others	*2.24*

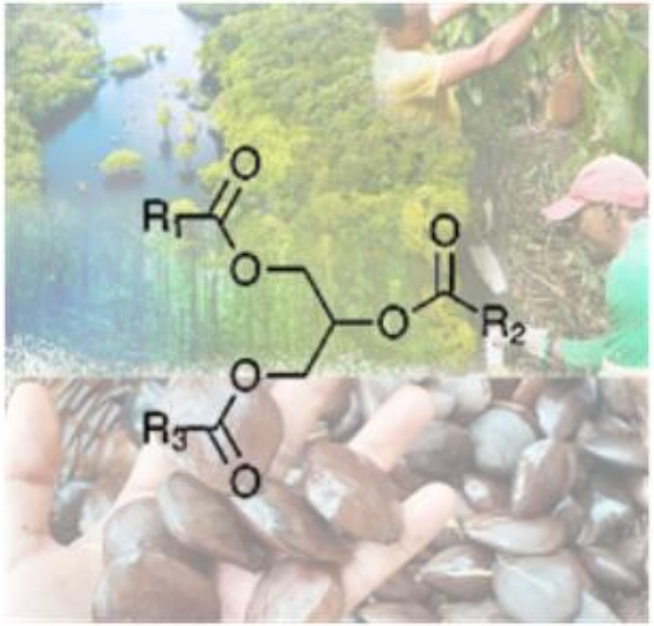
No need for hydrogenation, hydrolysis, or fatty acid distillation;

Since Pracaxi Oil naturally has large amounts of behenic acid (the highest known in the world), hydrogenation is not required, avoiding this expensive and hazardous step.

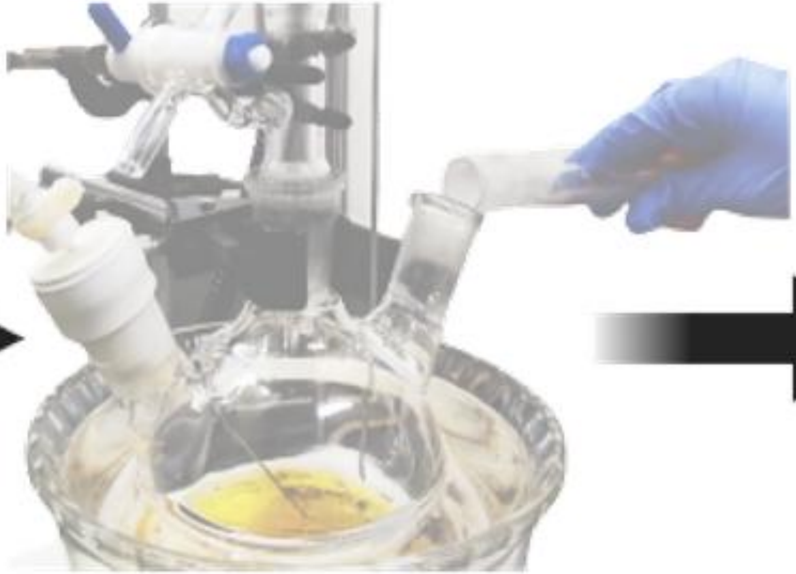


Methodology

Production and Chemical Characterization



Pracaxi Oil



isolation/amidation
of fatty constituents

AAPDMA C22-C24

Characterization:
FTIR; ^{1}H NMR

Methodology

Preliminary Formulations and Tests

Hair Masks and Hair Conditioners Evaluation

Hair masks formulations:
3.2wt% surfactant
8% cetearyl alcohol
Lactic Acid 85% until pH 4 or 4.5
AAPDMA C22-C24, BAPDMA and BTAC

Hair conditioners formulations:
2wt% surfactant
5% cetearyl alcohol
Lactic Acid 85% until pH 4 or 4.5
AAPDMA C22-C24, BAPDMA and BTAC

- Performance evaluation by sensory tests:

  Application **Wet detangling**

  Wet detangling **Dry fell**

- Performance evaluation by brightness measurement (hair shine)
- Rheometry analysis

Second Batch of Formulations and Tests

Phase	Ingredient	wt %	wt%	wt %	wt%
A	Water	89,85	89,80	89,85	89,85
	Glycerine	2,00	2,00	2,00	2,00
	Behenamidopropyl Dimethylamine (BAPDMA)	2,00	-	-	-
	Behentrimonium Chloride (and) Isopropyl Alcohol)	-	2,40	-	-
	AAPDMA C22-C24	-	-	2,00	-
	Brassica A			-	2,00
B	Lactic Acid (Solution 85%)	0,35	-	0,35	0,35
C	Cetearyl alcohol	5,00	5,00	5,00	5,00
D	Preservative	0,80	0,80	0,80	0,80

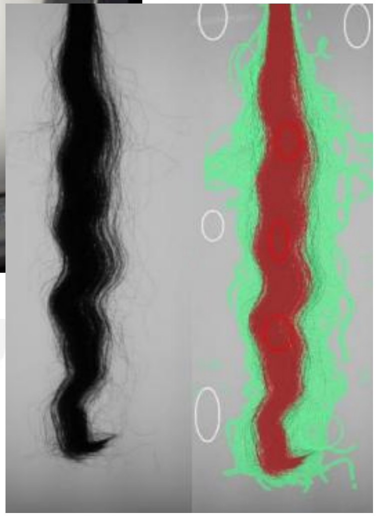
Combing Tests

Equipment

- Diastron® MTT175

Frizz

- Image Analysis



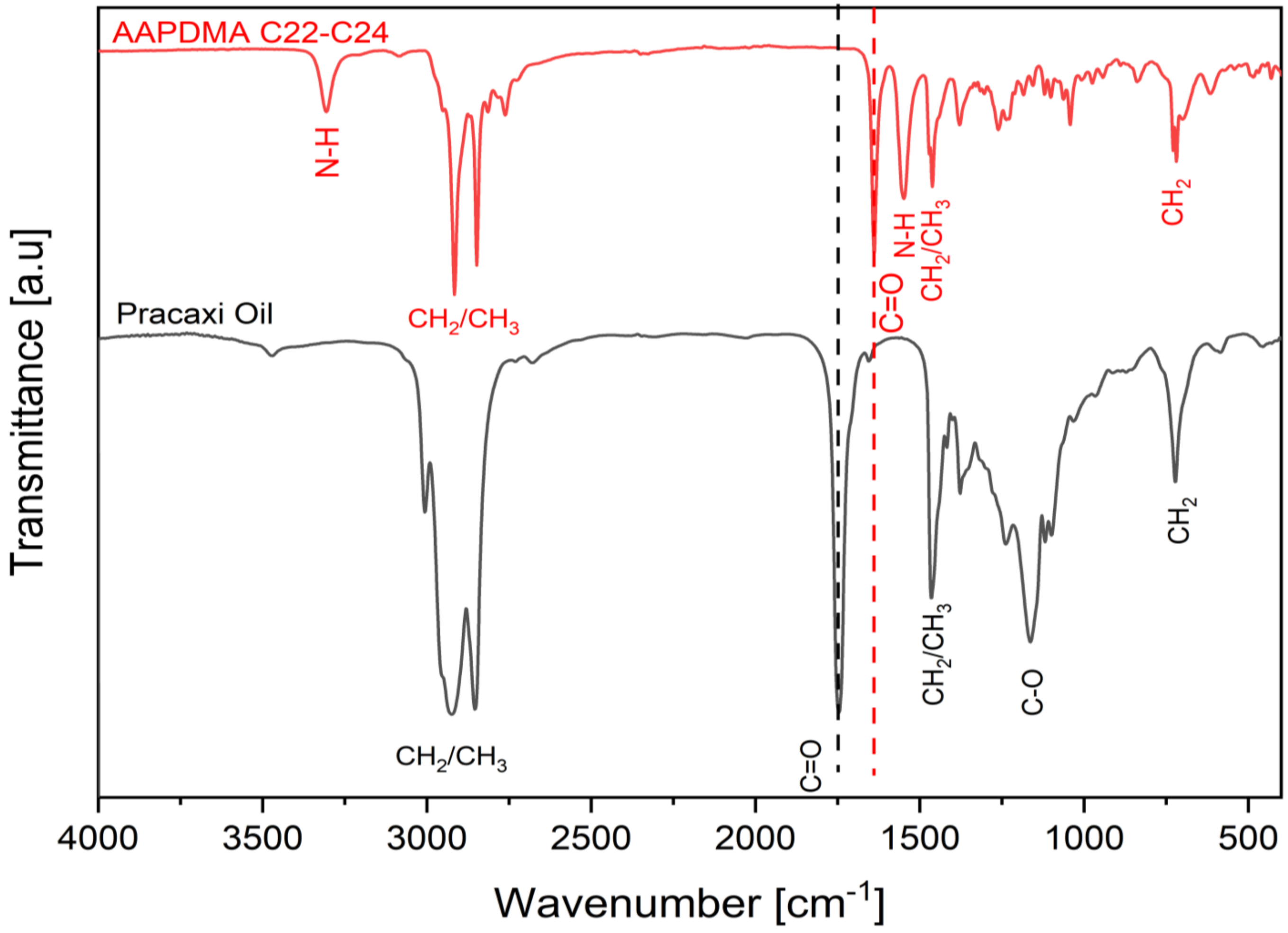
Hair Shine/Gloss

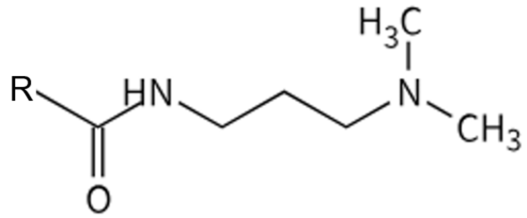
Equipment

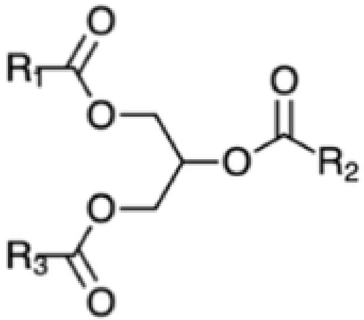
- Samba Hair

Results

Chemical Characterization - FTIR

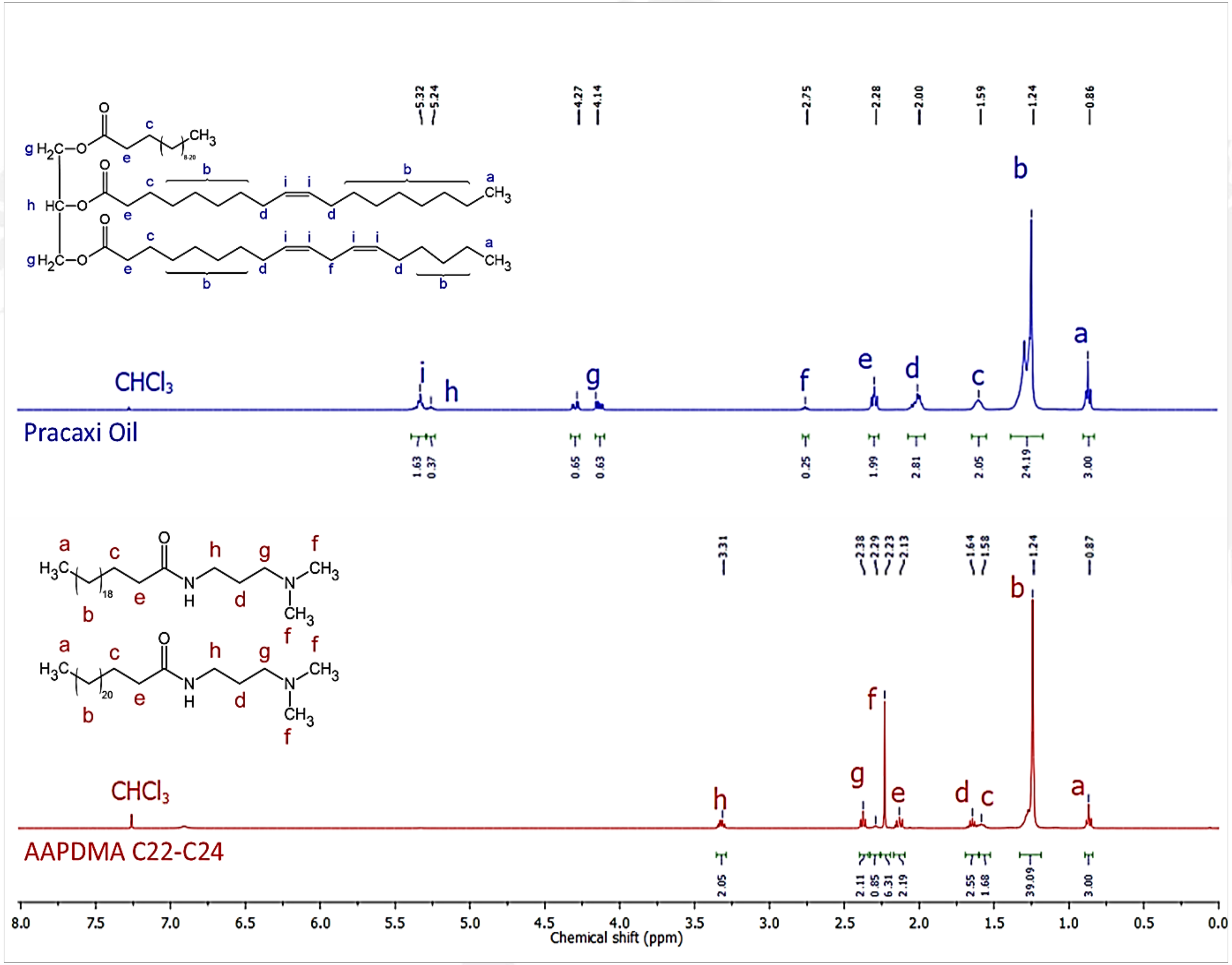






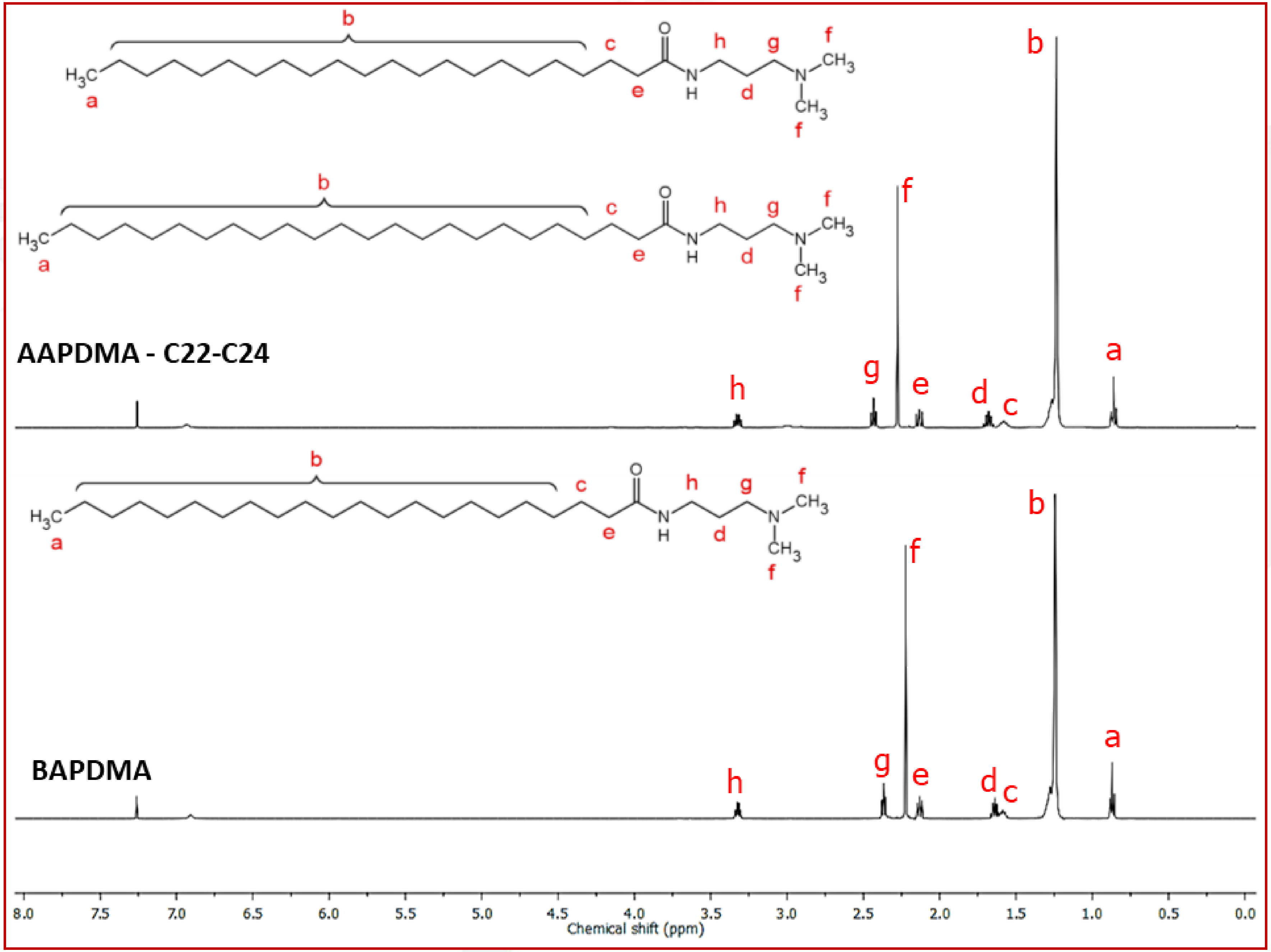
Results

Chemical Characterization
^{1}H NMR



Results

Chemical Characterization ^{1}H NMR

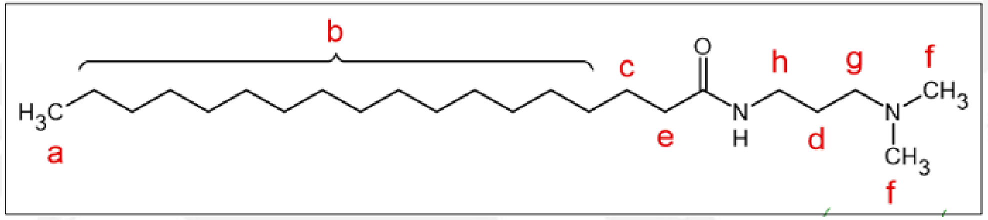


Alkylamidopropyl dimethylamines

Results

Chemical Characterization

¹H NMR



Area of b sign at 1,2 ppm

C18 – 28H

C22 – 36H

C24 – 40H

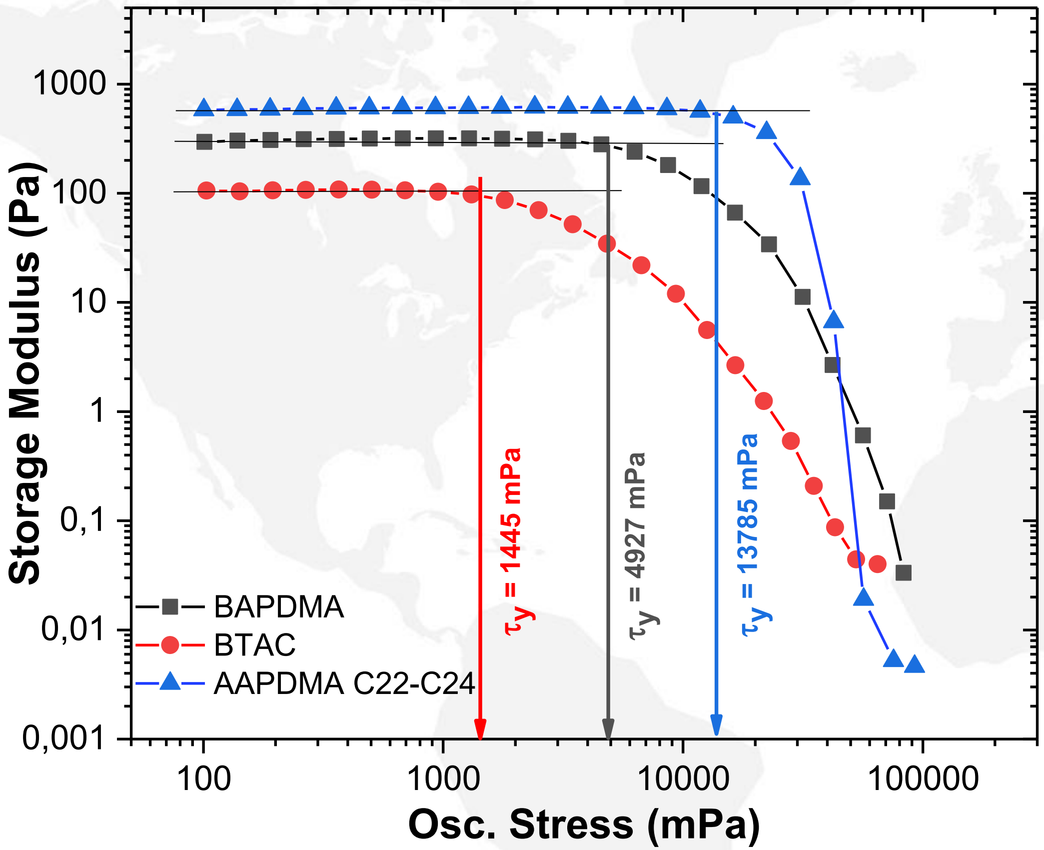
AAPDMA C22-C24

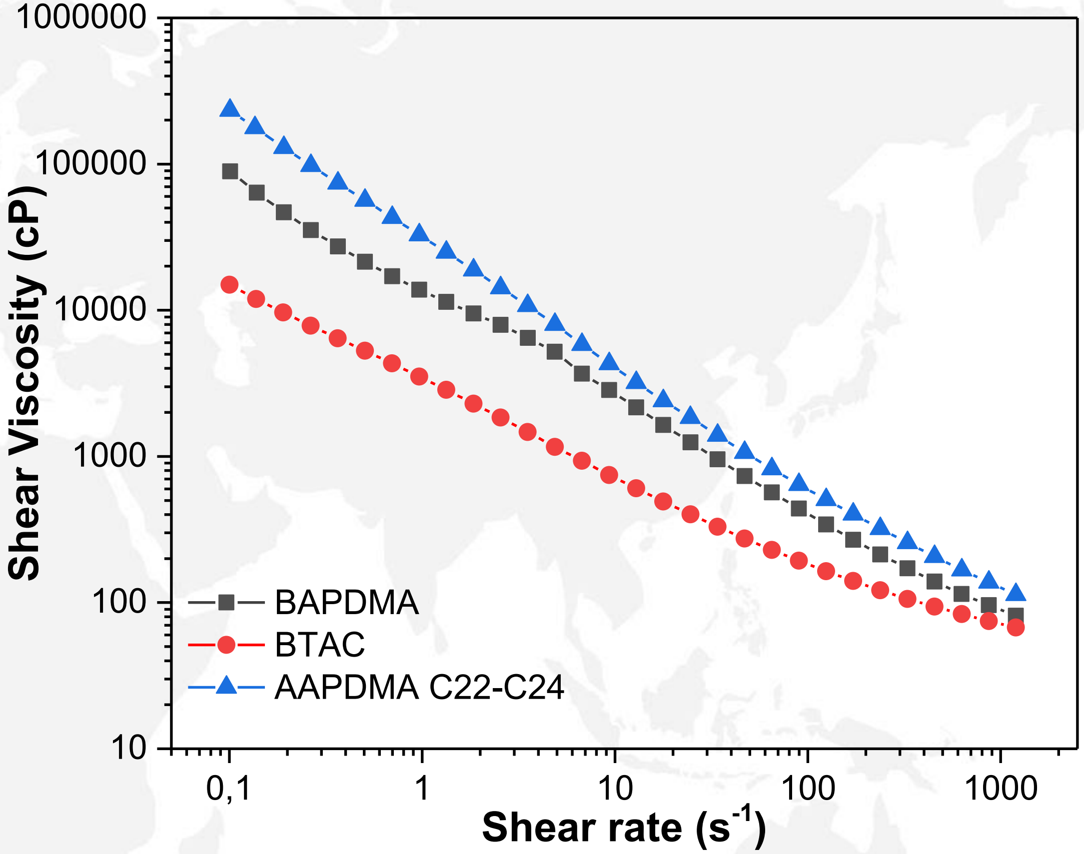
Area of the sign at 1,2 ppm:

37,30

Results

Rheological Characterization

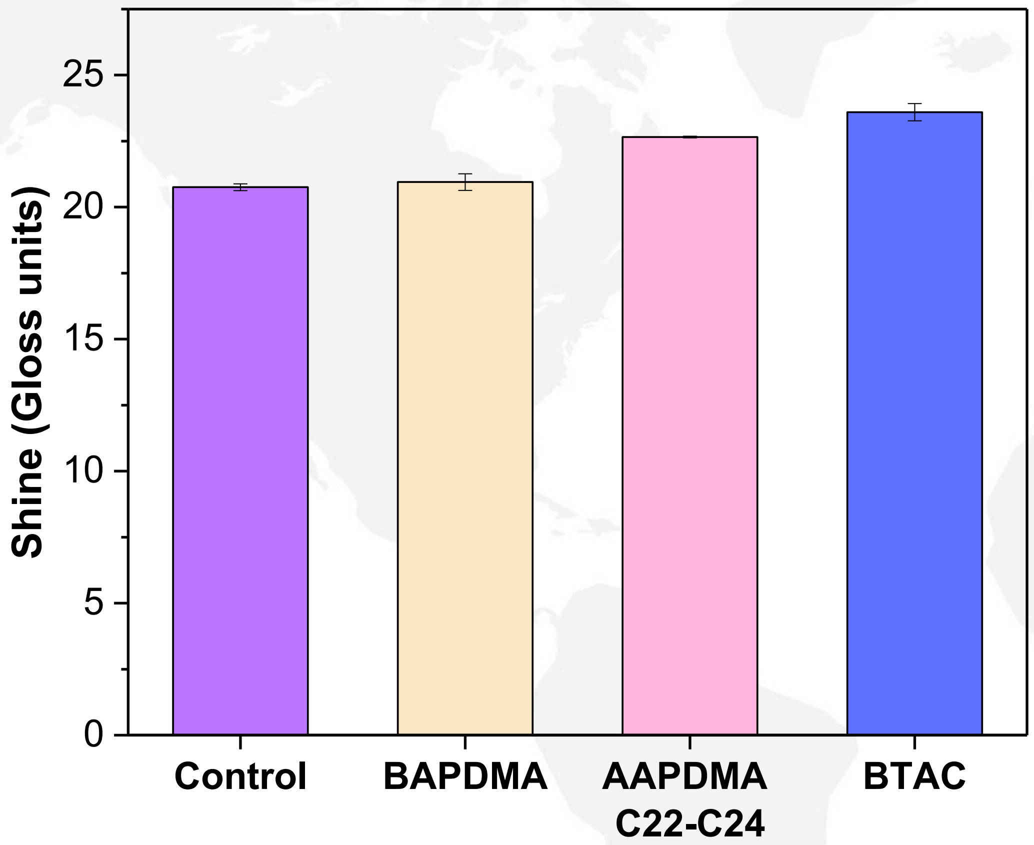


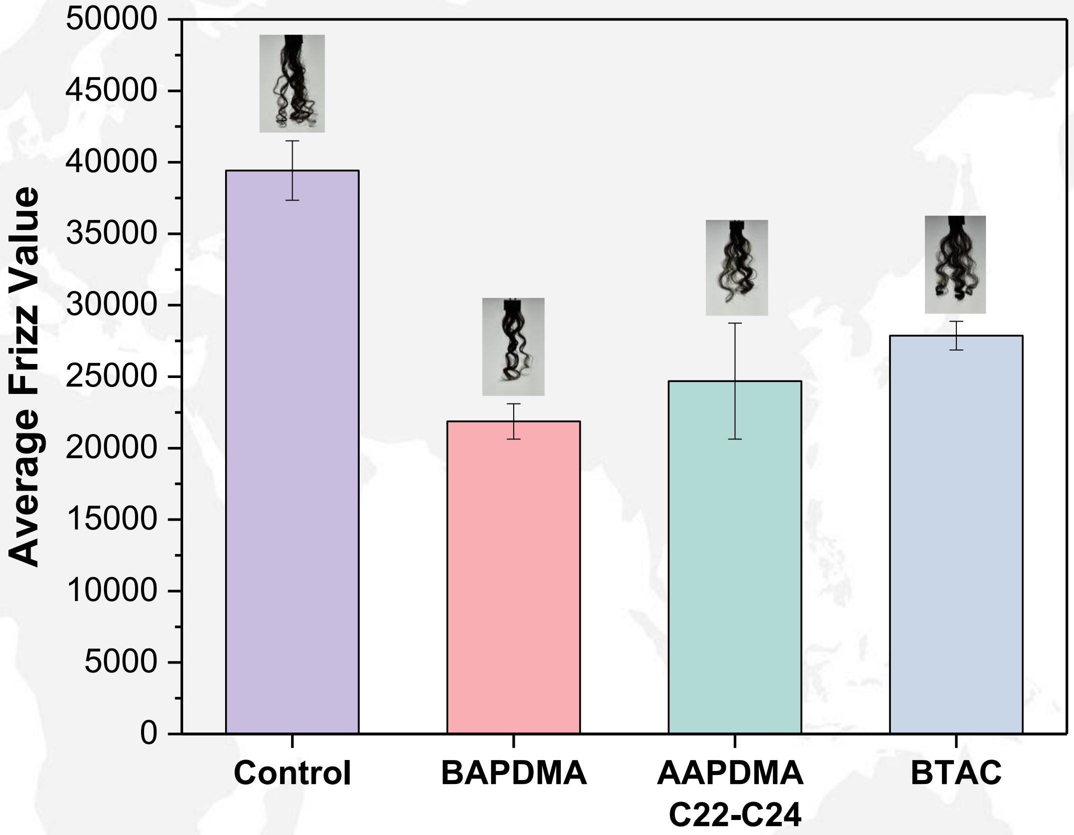


Oscillation amplitude sweeps (left) and steady-state rotational (right) rheological curves presented for hair conditioners produced with the different surfactants applied as agent.

Results

Brightness and Frizz

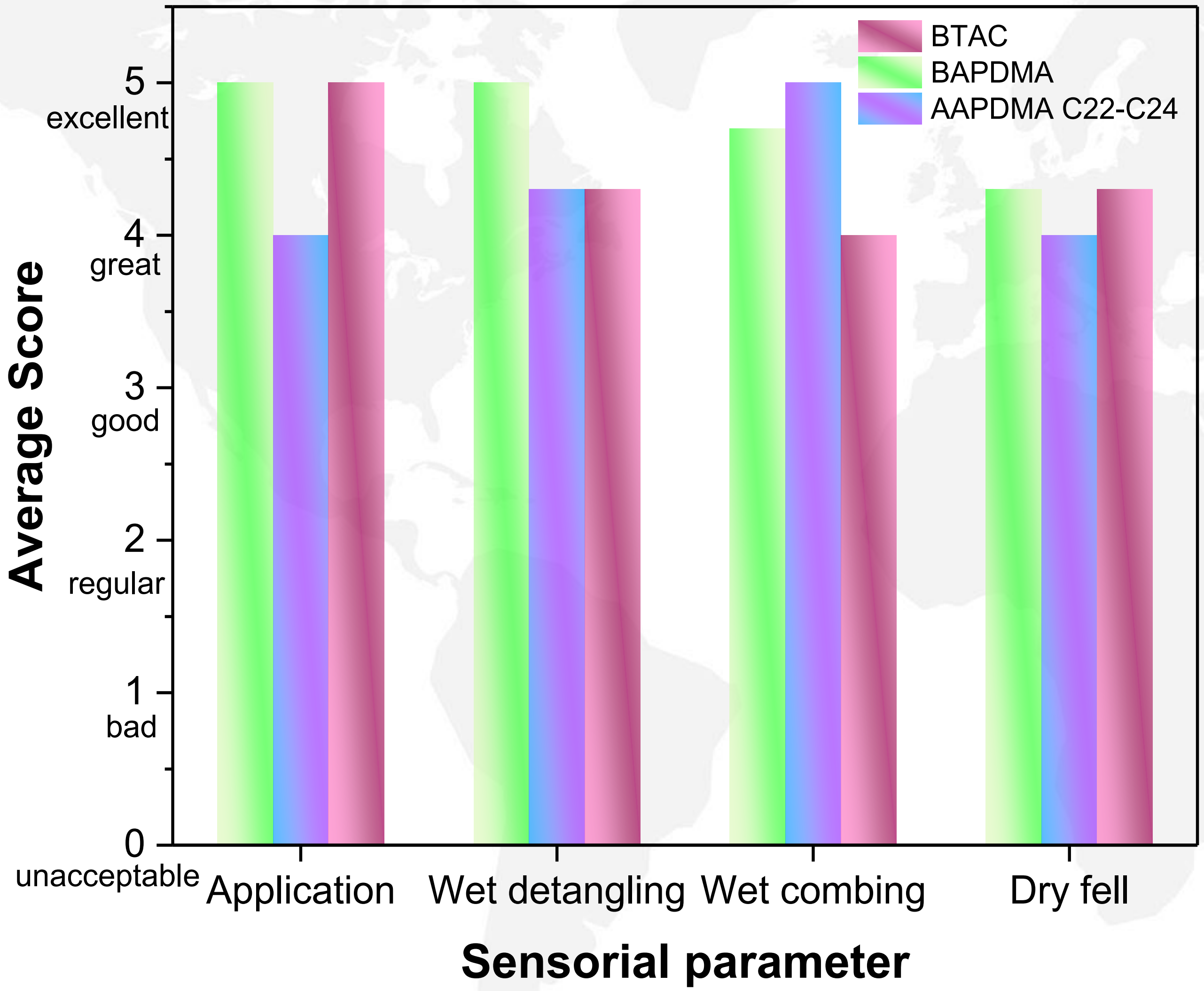




Brightness (left) and frizz (right) measurements of the hair conditioners produced with the different surfactants applied as agent.

Results

Sensorial Tests



Sensory results of the evaluated hair conditioners produced with the different surfactants applied as agent.

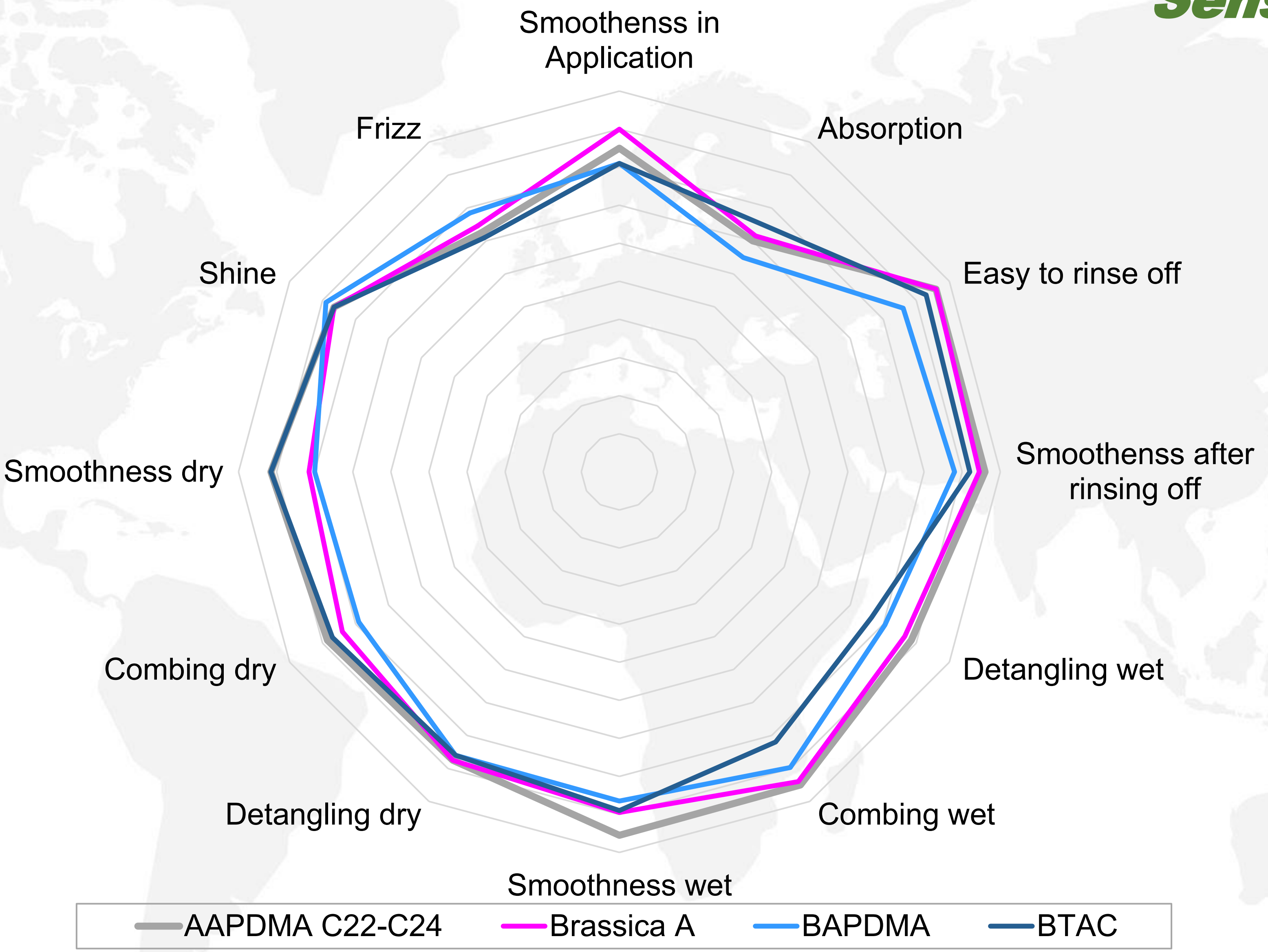
Results – Second Batch

Sensorial Tests

			Evaluation	AAPDMA C22-C24	Brassica A	BAPDMA	BTAC
Leave On Conditioner	During Aplication	WET	Smoothenss in Application	4,3	4,5	4,1	4,1
			Absorption	3,5	3,6	3,3	3,8
			Easy to rinse off	4,8	4,8	4,3	4,7
			Smoothenss after rinsing off	4,8	4,7	4,4	4,6
	Wet Evaluation		Detangling wet	4,4	4,3	4,0	3,8
			Combing wet	4,8	4,7	4,5	4,1
			Smoothness wet	4,8	4,5	4,3	4,5
	Dry Evaluation	DRY	Detangling dry	4,4	4,4	4,3	4,3
			Combing dry	4,4	4,2	4,0	4,4
			Smoothness dry	4,6	4,1	4,0	4,6
			Shine	4,3	4,3	4,5	4,3
			Frizz	3,6	3,7	3,9	3,6

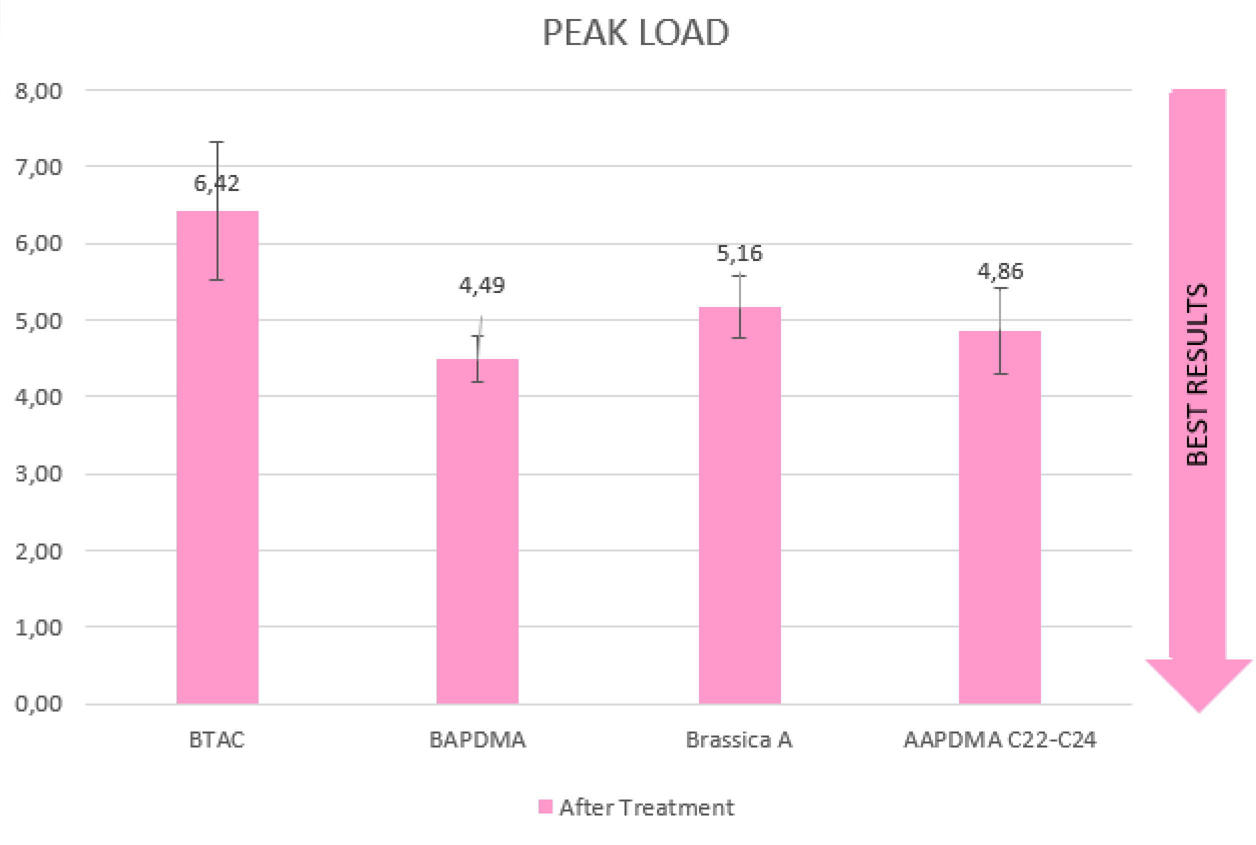
Results – Second Batch

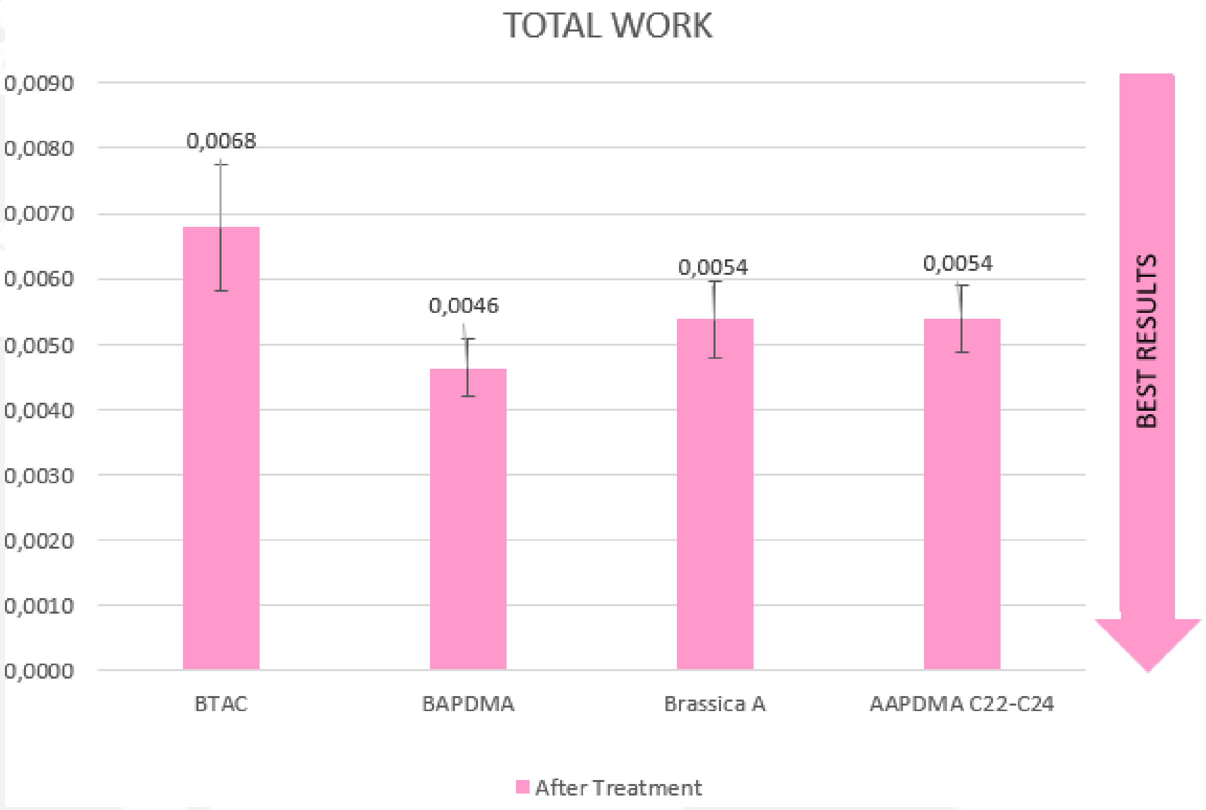
Sensorial Tests



Results – Second Batch

Combing Tests





Conclusions

A novel green conditioning agent (AAPDMA C22–C24) was successfully developed from sustainably sourced Amazonian pracaxi oil;

Unlike conventional pracaxi-derived products, AAPDMA C22–C24 is enriched in the long saturated C22 and C24 chains, providing performance comparable to BAPDMA.

The product showed conditioning performance comparable to commercial BAPDMA while being produced through a simpler route that eliminates hydrogenation, hydrolysis, and distillation, reducing energy consumption, production costs, and carbon footprint;

The use of sustainably harvested pracaxi oil strengthens both environmental and social sustainability by supporting Amazon forest conservation and generating fair income for local communities.

Overall, AAPDMA C22–C24 represents a high-value green ingredient produced through a cleaner, more sustainable, and economically attractive process.

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Acknowledgements

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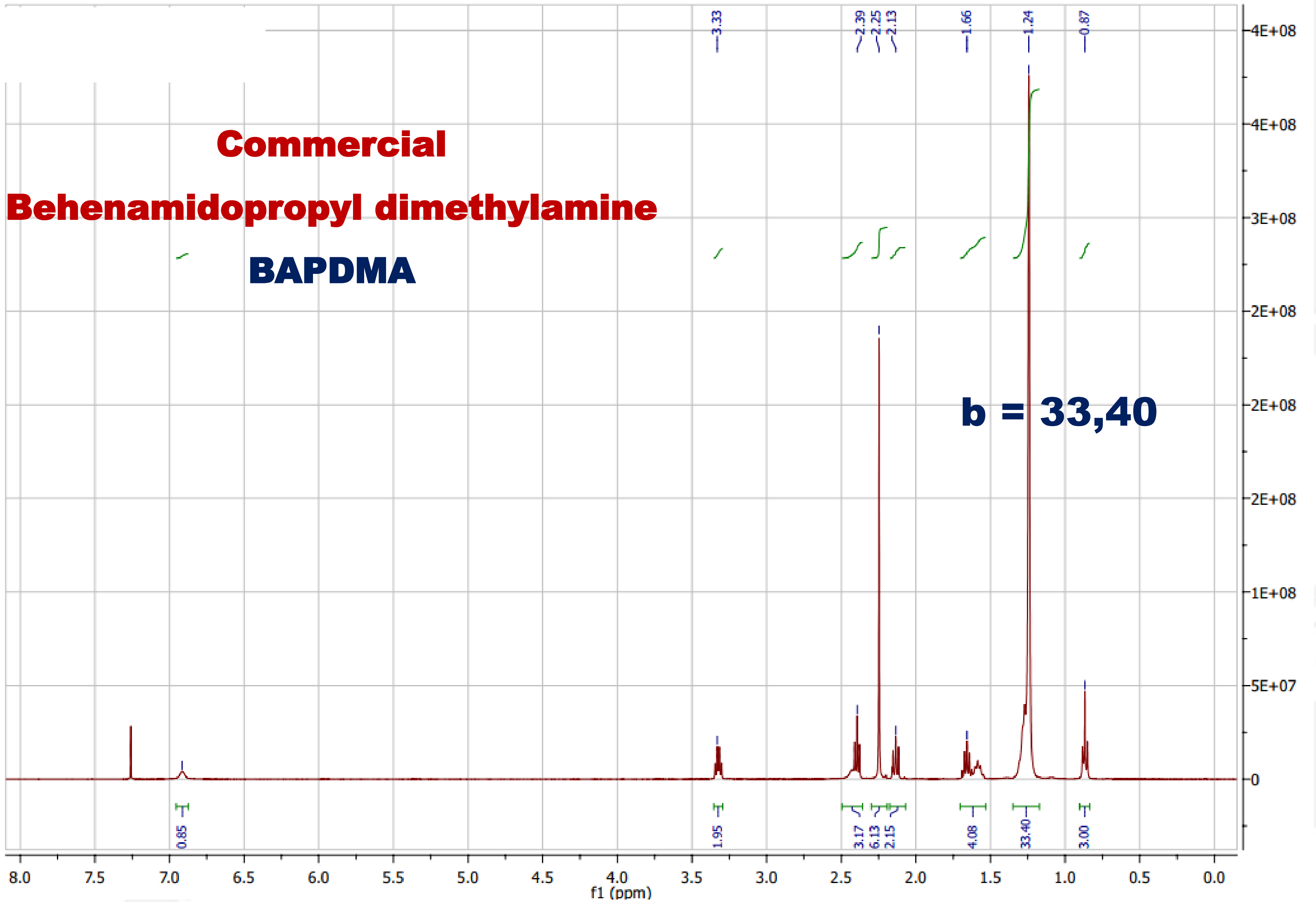
CRODA
Beauty

Grupo IPclin
Pesquisa Integrada

Bielus
ingredientes

More about Commercial BAPDMA



Sources of Erucic Acid – Brassica Species

TABLE 3

Means composition of oil content and main fatty acids for six species of *Brassica*

Species	*Oil content (%)*	*C16:0*	*C18:0*	*C18:1*	*C18:2*	*C18:3*	*C22:1*	*Total*^{a}	*U/T*^{b}
Brassica napus	46.76^{a*}	4.52^{a}	2.36^{a}	61.83^{a}	17.26^{b}	6.84^{e}	1.16^{e}	93.99^{a}	0.92^{d}
Brassica juncea	25.86^{e}	3.68^{b}	1.36^{b}	14.39^{c}	19.92^{a}	20.22^{a}	31.27^{d}	91.17^{c}	0.94^{c}
Brassica carinata	26.93^{d}	3.27^{bc}	0.96^{c}	10.08^{e}	17.67^{b}	18.37^{c}	40.56^{b}	90.92^{c}	0.95^{ab}
Brassica oleracea	28.58^{c}	3.60^{b}	0.79^{d}	15.01^{c}	12.66^{c}	14.98^{d}	46.19^{a}	93.26^{b}	0.95^{ab}
Brassica nigra	21.62^{f}	3.65^{b}	1.44^{b}	12.84^{d}	17.84^{b}	19.46^{b}	34.87^{c}	89.83^{d}	0.94^{bc}
Brassica rapa	31.95^{b}	2.63^{c}	1.44^{b}	18.19^{b}	13.00^{c}	16.00^{d}	41.84^{b}	93.13^{b}	0.95^{a}

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Table 1. Fatty acid composition of different released varieties and advanced lines of *Brassica campestris*

Name of the variety (Treatments)	Percentage of fatty acids							
	Palmitic Acid ($C_{16:0}$)	TSFA	Oleic Acid ($C_{18:1}$)	Linoleic Acid ($C_{18:2}$)	Linole-nic Acid ($C_{18:3}$)	Ecosenic Acid ($C_{20:1}$)	Erucic Acid ($C_{22:1}$)	TUSFA
BARI Sarisha-9	2.82a	2.82a	7.00d	19.21a	19.18a	13.52a	38.11d	97.02b
BARI Sarisha-12	2.92a	2.92a	14.28b	17.42b	9.32b	5.40c	50.50bc	96.92b
BARI Sarisha-14	1.94c	1.94c	12.37c	15.36cd	8.97b	8.18b	52.71ab	97.59b
BARI Sarisha-15	2.22b	2.22b	15.40b	16.06c	9.15b	7.66b	48.70c	96.97b
Din-2	0.627d	0.627d	13.82bc	14.94d	9.987b	6.06c	54.56a	99.36a
BC-2193	2.64a	2.64a	17.58a	14.49d	6.837c	8.02b	49.28c	96.02c
LSD (0.05)	0.2613	0.2613	1.723	0.8750	1.404	1.108	2.442	0.718
CV (%)	6.84	6.84	7.46	3.13	7.70	7.90	2.89	0.43

Converting Commercial BAPDMA to High Purity BAPDMA

Commercial

Behenamidopropyl dimethylamine

BAPDMA

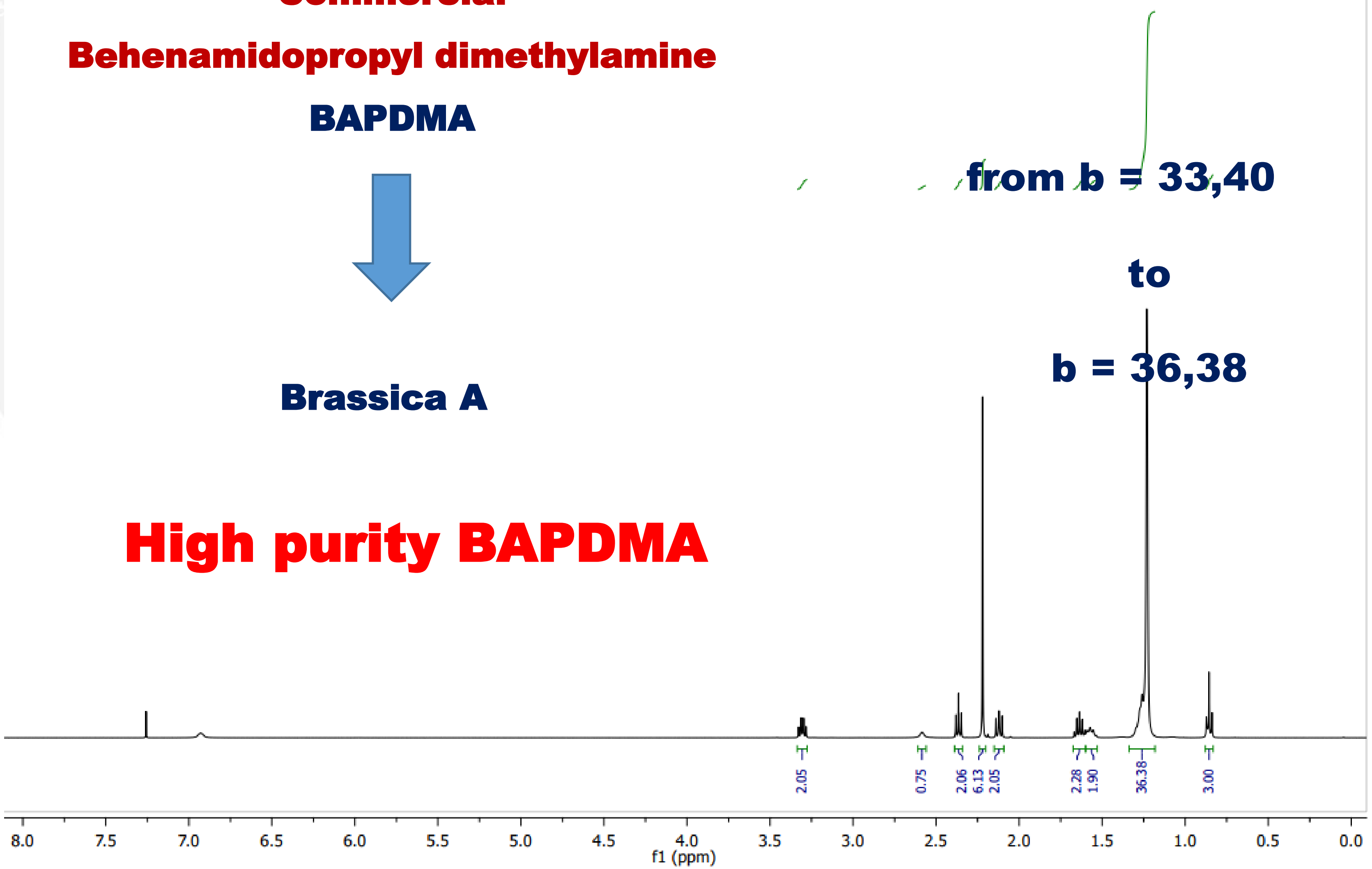
Brassica A

High purity BAPDMA

from b = 33,40

to

b = 36,38



Acute Toxicity Assays with *Vibrio Fischeri*

Microtox Experiments

	pH 4,5		pH 6,5 (adjusted for the test)	
	CE20 (mg/L)	CE50 (mg/L)	CE20 (mg/L)	CE50 (mg/L)
APA-18	3,368	9,937	3,305	13,67

*in the limits of the test