1st International Congress
on Food Technology
November 03 – 06, 2010
Antalya, Turkey

Control of the degradation of frying fats during usage

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During the frying process

the frying fats and oils

undergo

chemical changes.

These changes

are initiated and essentially caused by

high temperatures,

reactions between lipid molecules,

oxygen,

water from the fried goods,

other substances from the fried goods.

Some of the compounds formed

are undesired because of their

odour,

taste,

colour,

and a possibly negative effect for health.

Most of the newly formed compounds

have a higher polarity

than the triglycerides.

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have a higher polarity

than the triglycerides.

They are therefore referred to as

total polar material (TPM).

The mass concentration of TPM

in a frying fat is

one of the quality criteria

and indicates its freshness.

The allowed mass concentration

of TPM

is therefore limited in some countries.

In Germany the limit is 24% by mass,

other countries have similar restrictions.

For this reason,

the measurement of TPM

is an important analysis

in the quality assessment of food.

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the measurement of TPM

is an important analysis

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To protect customers immediately,

this analysis should be as quick as possible.

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two official methods to quantify TPM.

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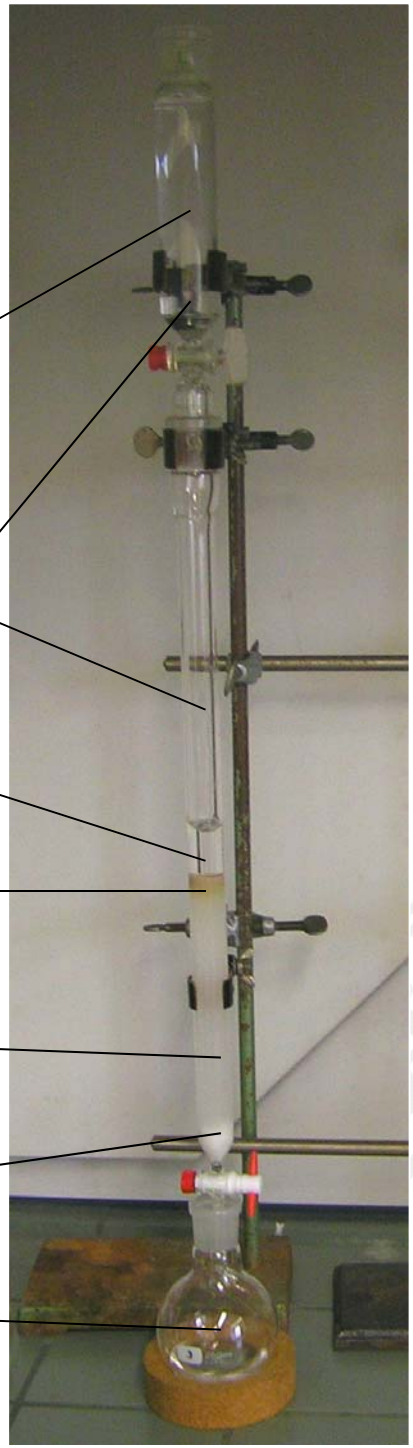
two official methods to quantify TPM.

They are both based on preparative column chromatography.

One method uses a big column.



Dropping funnel

Chromatographic column

Eluting solvent

petroleum ether / diethyl ether 87:13 (v/v)

Sea sand

Silica gel (25 g)

Cotton wool

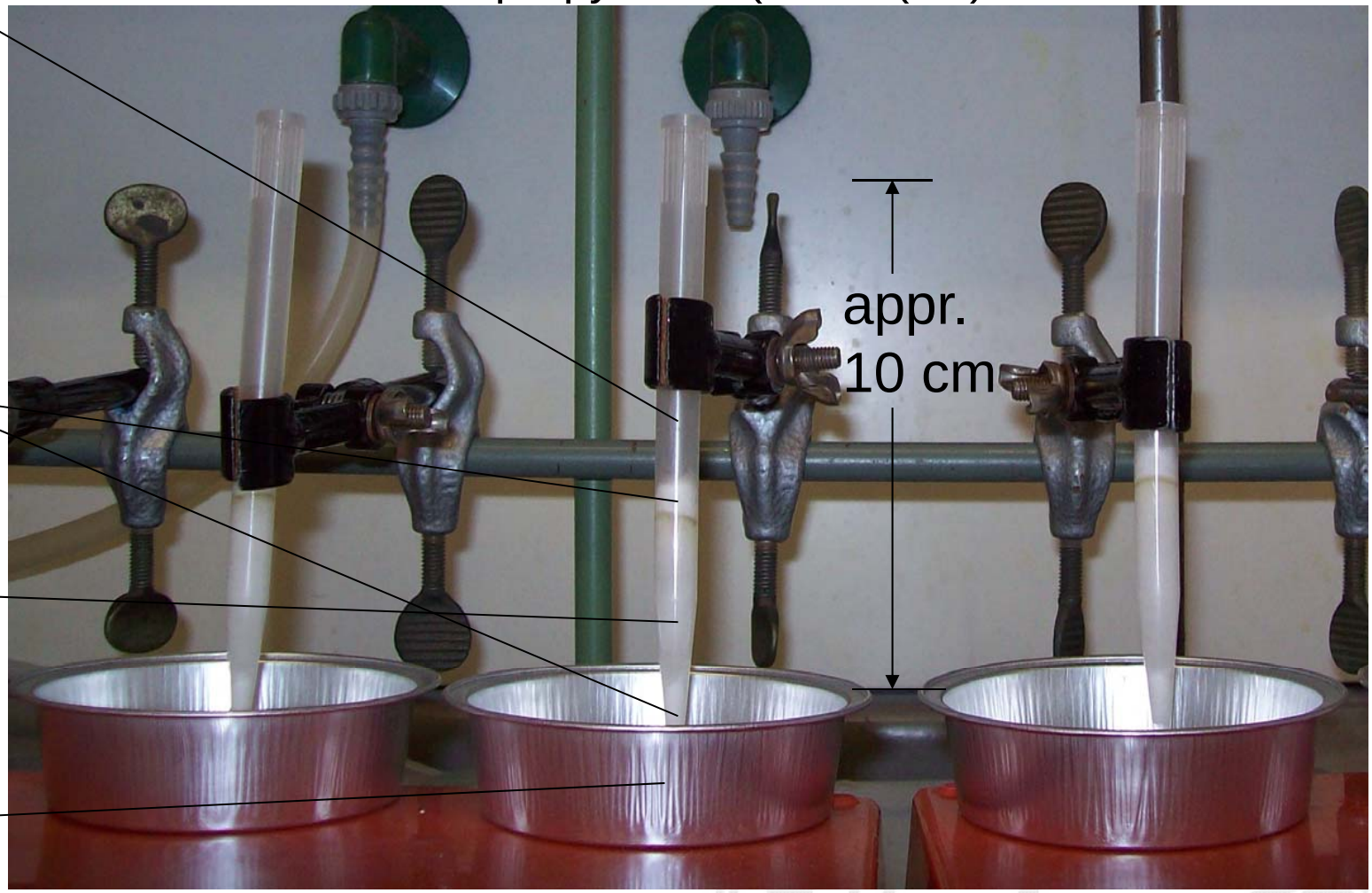
Round-bottomed flask

45 cm

Ø 2.1 cm

The other method uses small “columns” (pipette tips).

Eluting solvent isooctane / diisopropy ether (85:15 (v/v)



Both methods need

inflammable solvents,

laboratory equipment,

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inflammable solvents,

laboratory equipment,

experienced personnel

and

much time.

Results are obtained

the day after taking samples (at the earliest).

Consequences can only be taken

after a long delay.

Both chromatographic methods separate the oil into two fractions.

The non-polar fraction is eluted and the polar fraction (TPM) is calculated as difference of the the sample size and the mass of the non-polar fraction obtained.

An alternative method

measures the

dielectric number

of the oil with a probe

without prior separation.

The temperature is also measured

to compensate the dependence of

the dielectric number from temperature.

This “dielectric technique”

takes only a couple of minutes,

needs no chemicals,

no laboratory,

no experienced personnel

and can be applied “on the spot”.

Are the analytical results of

the dielectric technique

comparable with

the chromatographic (gravimetric) method?

Comparative measurements

were made with various oils

in pure form

and with goods:

Potatoes

Carrots

Palm fat

Parsnips

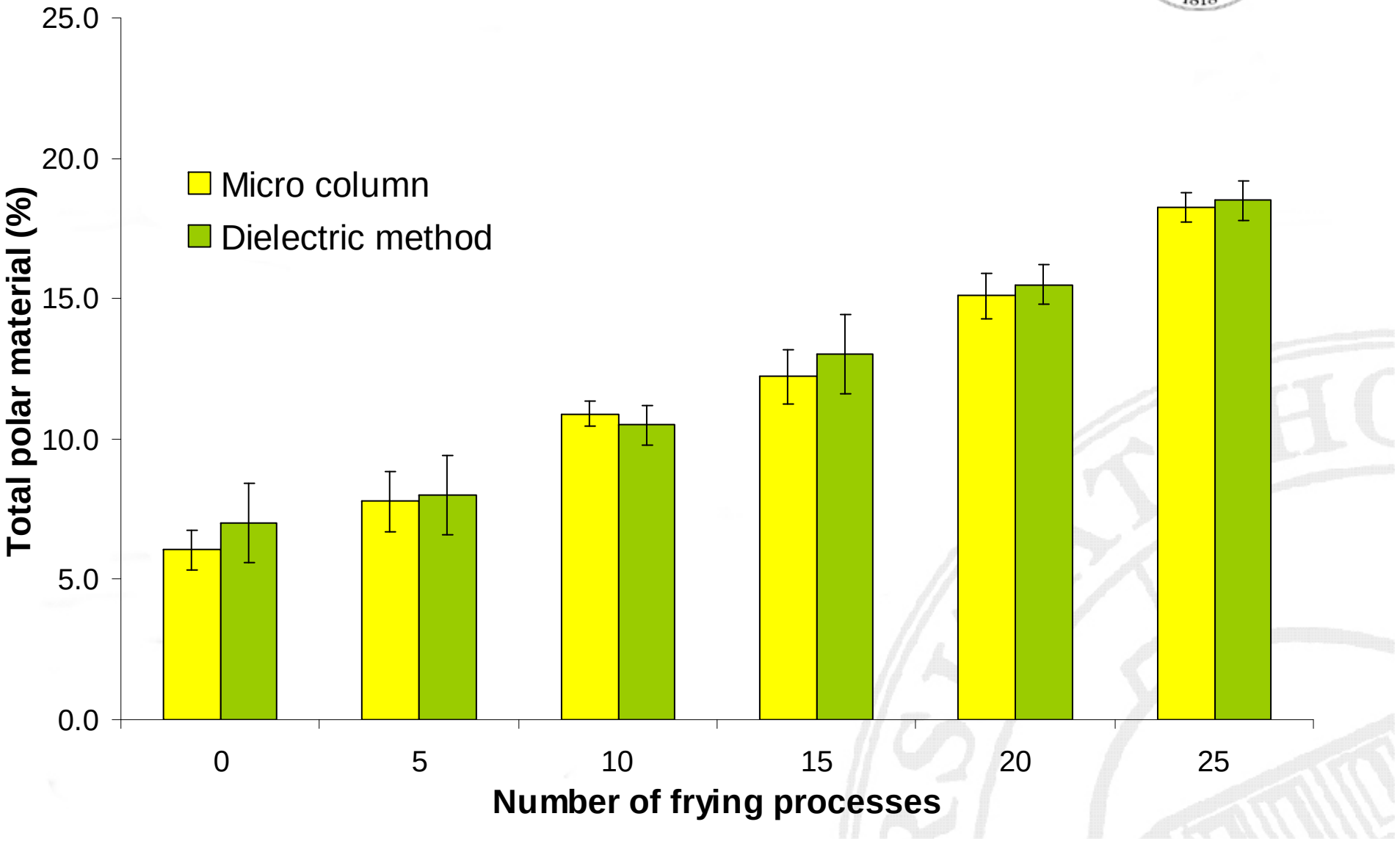
Rapeseed oil

Sunflower oil

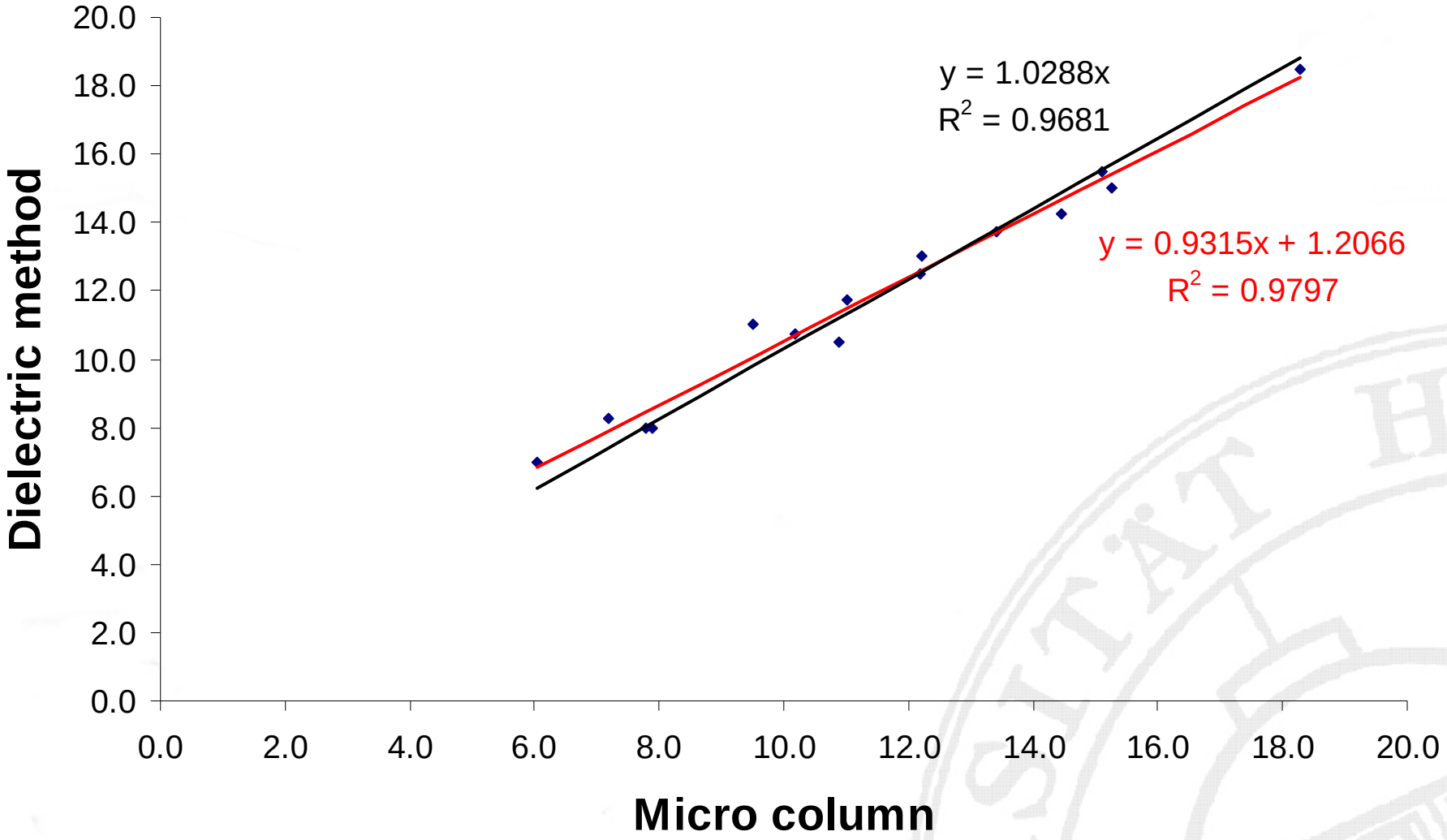
Fish fillets

Chicken breast fillets

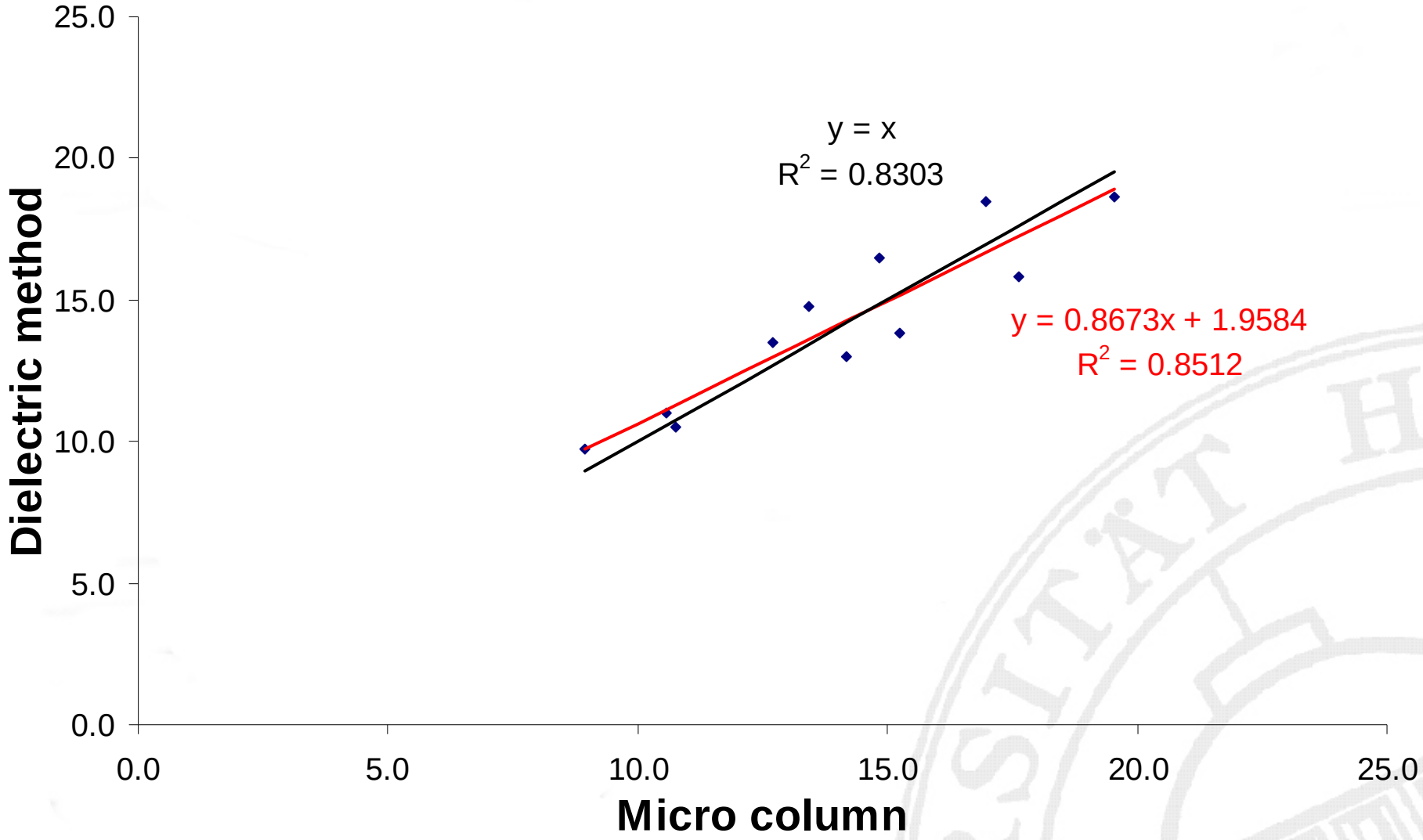
Example:


Potato strips in refined palm fat
Micro column
Dielectric method
Total polar material (%)
25.0
20.0
15.0
10.0
5.0
0.0
0
5
10
15
20
25
Number of frying processes

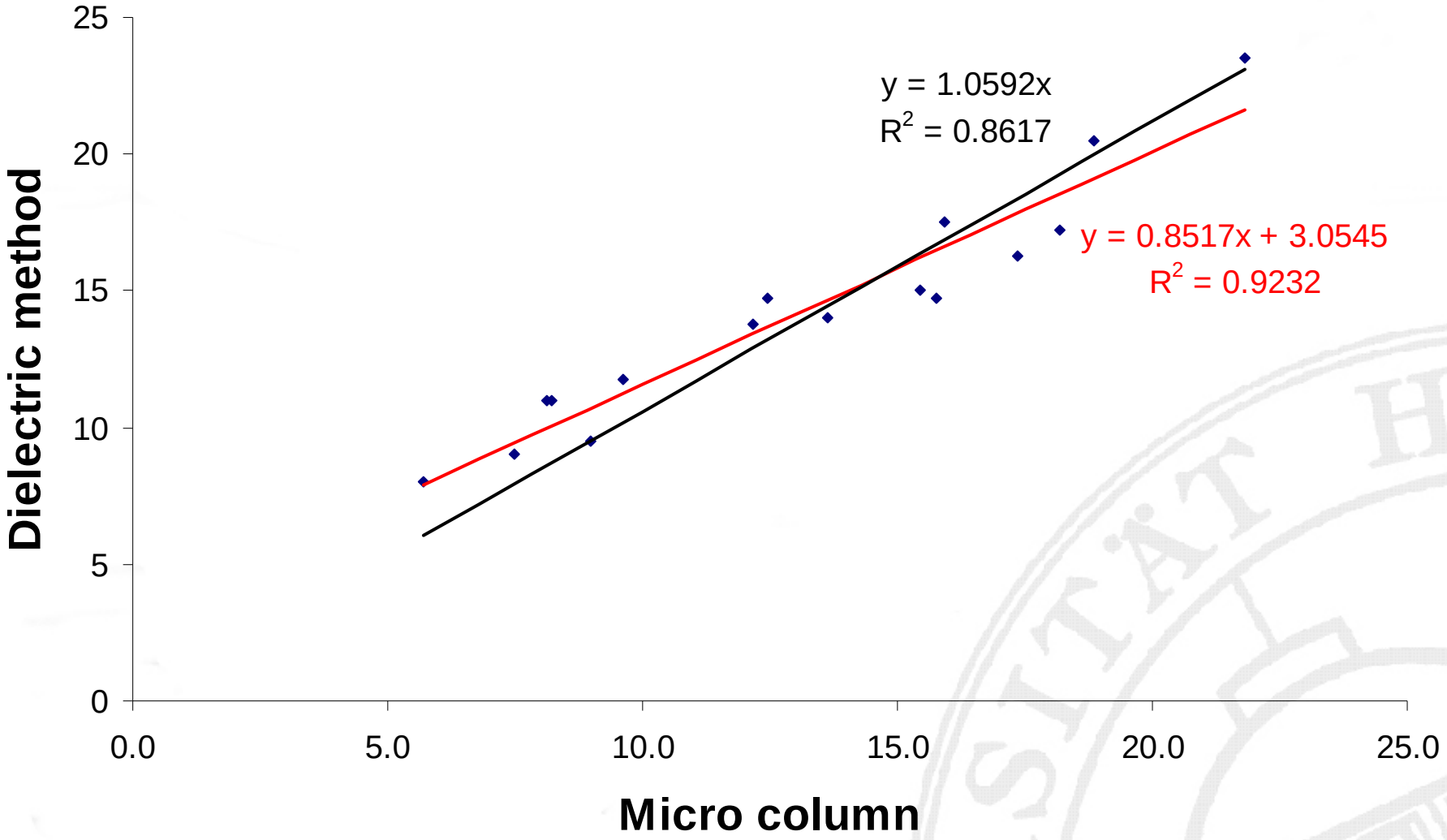
Refined palm fat with plant products



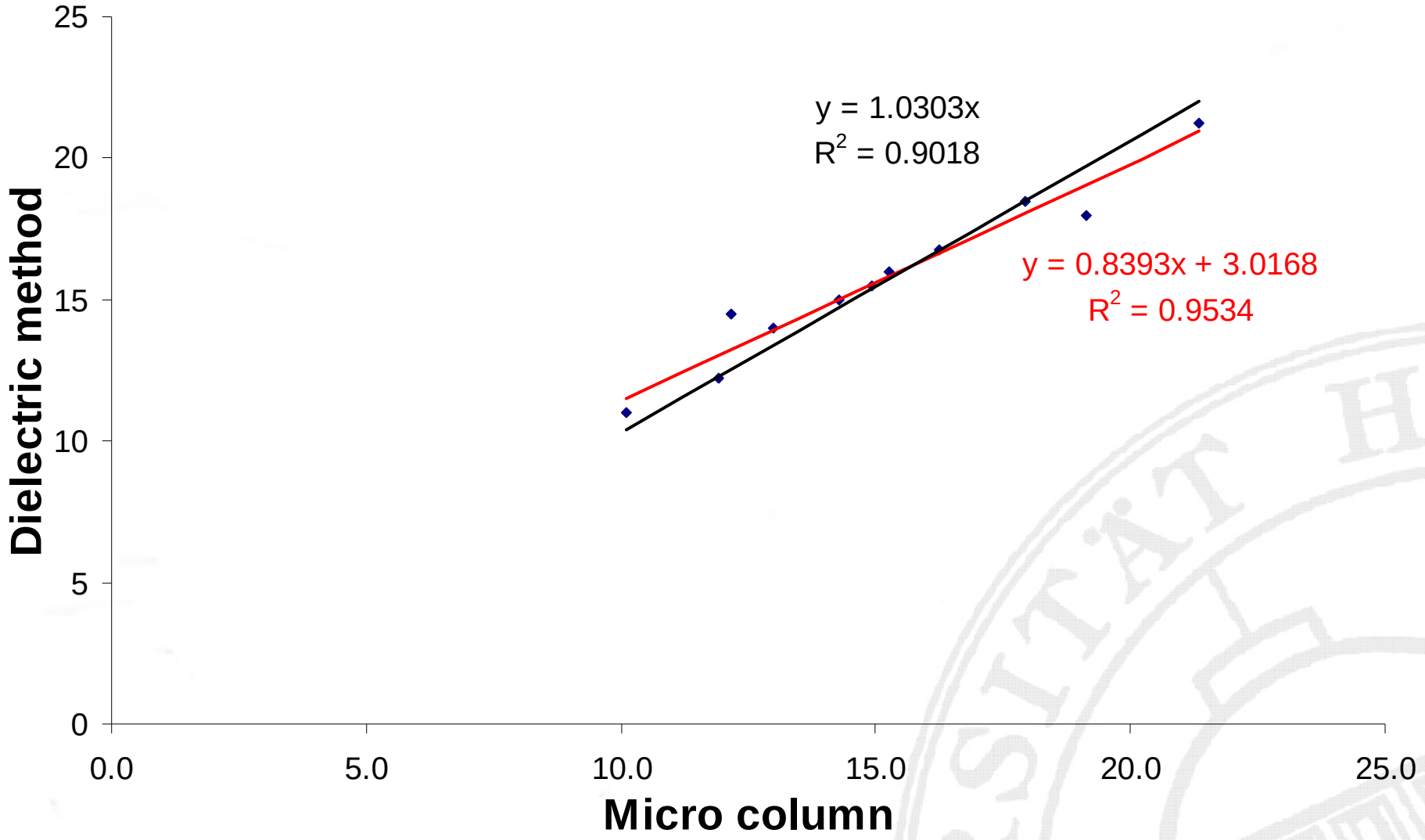
Refined palm fat with animal products



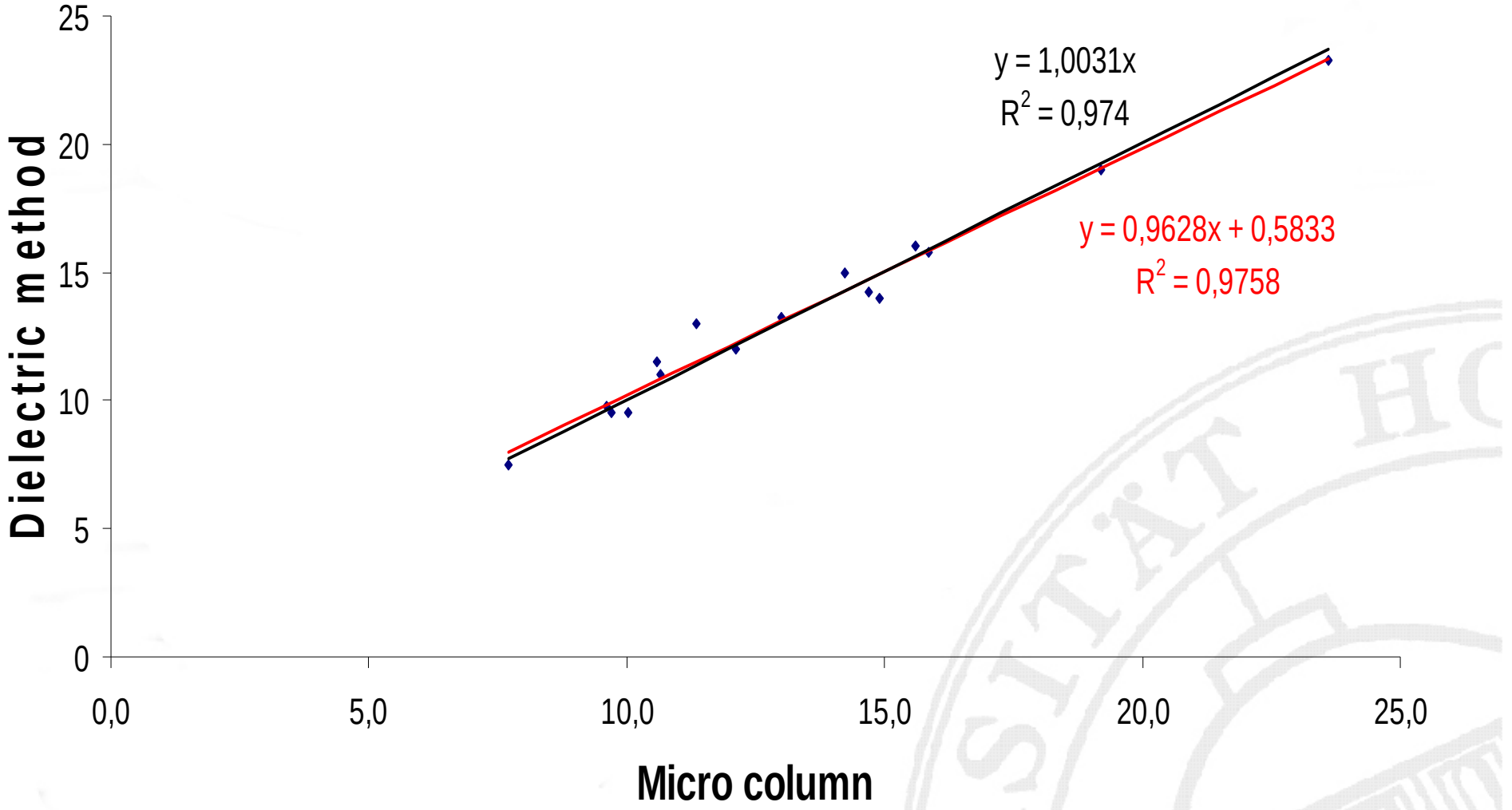
Rapeseed oil with plant products



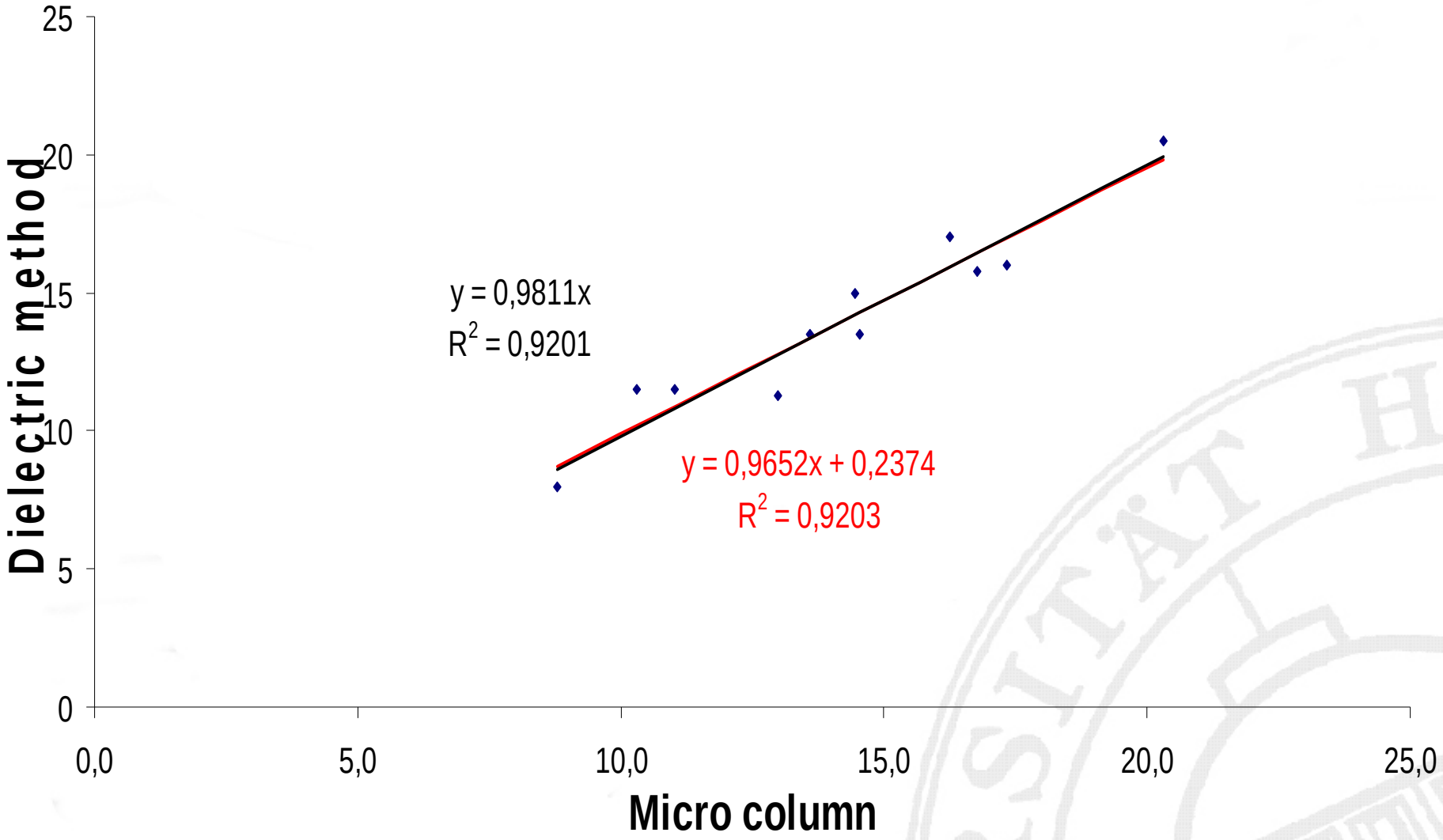
Rapeseed oil with animal products



High-oleic sunflower oil with plant products



High-oleic sunflower oil with animal products



In all of the cases

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has a positive intercept.

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the line with the best correlation coefficient

has a positive intercept:

The dielectric probe does not display 0%

when the chromatographic method indicates

0% TPM.

Reason for this fact is that

the „non-polar“ fraction of the oil

has also a slight polarity.

The separation into the two fractions

depends on the chromatographic parameters.

It could be shown

that the TPM value found for given oils

depends strongly on the ratio

of the two solvents.

The “border line” between the two fractions

is therefore arbitrary

and a question of definition.

This “border line” is not relevant

for the dielectric method.

It analyses the oil as such

without prior separation

and includes also the

“non-polar” components.

A further principle difference

between the chromatographic method

and the dielectric technique exists:

In the chromatographic method

the mass of the molecules collected

in the polar fraction is the decisive property.

In the dielectric technique the decisive entity

is the polarity of every single molecule

in the whole oil.

The correlation between

the chromatographic method

and the dielectric technique is good,

in spite of the different analytical aspects.

The advantages

of the alternative dielectric method

are, however, enormous.

It should be accepted

as official method.

Results presented here

were taken from the

PhD thesis of

my student Zainal from Indonesia.

Thank you !


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