Sudan Dyes in Foods

A Technical Presentation in

DIFSC2010

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Sudan Dyes in Foods

- 2003 May: Sudan I detected in Chilli products (France)
- 2003 July: The products contaminated with Sudan I in France were later found out to be produced in UK/produced in Italy and imported in to UK
- 2005 February: A Worcester sauce was reported to be contaminated with Sudan I. This contamination led over 400 products being taken off the shelves.

Cause of this contamination in many of these cases was linked to Chilli powder, chilli products or curry powder that had been illegally contaminated with Sudan dyes.

Sudan Dyes in Foods

- 2005 May: Sixty nine products were with drawn from sale by companies in UK due to presence of Para Red.
- 2005 – 2007: Sudan I traces were found in several spices (South Africa)

Sudan Dyes in Foods

Safety of Sudan dyes

- Sudan dyes are suspected carcinogens
- IARC considers Sudan I,II,III,IV as Group 3 carcinogens
- Sudan dyes have been reported as contact allergens and sensitisers.

Sudan Dyes in Foods

Regulations:

- Sudan dyes are not permitted colours in food regulations of many countries/agencies (e.g., UAE, EU, Australia, Canada, China, Hong Kong, …).
- Their presence, at any level is not permitted in foods

Sudan Dyes in Foods

Introduction:

- Sudan dyes are Synthetic chemical dyes of similar chemical structure.
- They are oil-soluble, aromatic compounds containing azo group (-N=N-)
- Sudan I,II,III and IV are red dyes that are used for colouring hydrocarbon solvents, oils, waxes, petrol, plastics and shoe & floor polishes.

o Added to foods such as chilli powder to mimic/intensify their natural hues.

Sudan Dyes in Foods

Characteristics of Sudan dyes studied

Sudan dye	CAS Number	CI No	Chem. Class	Molecular Formula	Molecular weight
Sudan I	842-07-09	12055	Azo	$C_{16}H_{12}N_2O$	248.28
Sudan II	3118-97-6	12140	Azo	$C_{18}H_{16}N_2O$	276.33
Sudan III	85-86-9	26100	Azo	$C_{22}H_{16}N_4O$	352.39
Sudan IV	85-83-6	26105	Azo	$C_{24}H_{20}N_4O$	380.44
Sudan Red 7B	6368-72-5	26050	Azo	$C_{24}H_{21}N_5$	379.46
Para red	6410-10-2	12070	Azo	$C_{16}H_{11}N_3O_3$	293.28

Sudan Dyes in Foods

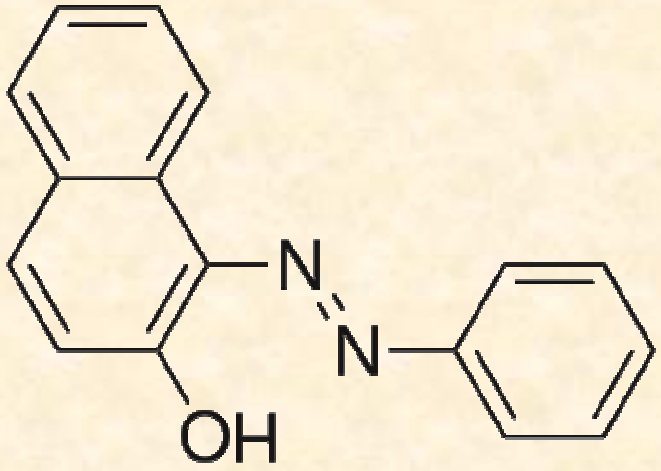
Characteristics of Sudan dyes studied

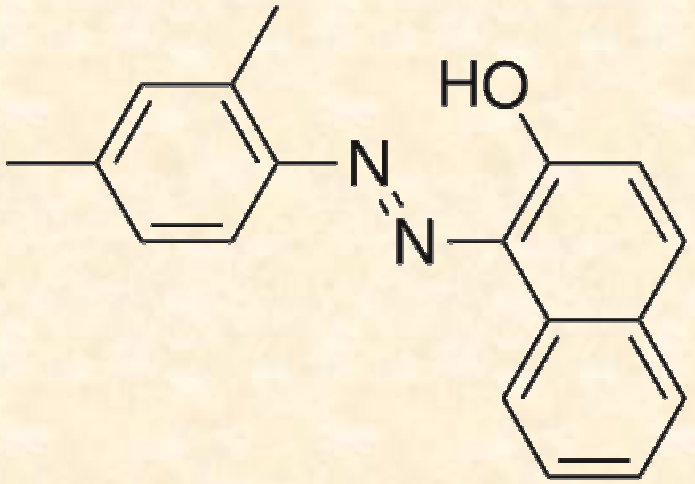
Sudan dye	Melting Point (° C)	λmax (nm) (Toluene)	Chemical name
Sudan I	131-133	476 (418)	1-phenylazo-2-naphthol
Sudan II	156-158	493 (420)	1-(2,4-Xylylazo)-2-naphthol
Sudan III	199 (dec.)	507 (354)	1-[4-(Phenylazo)phenylazo]-2-naphthol
Sudan IV	199 (dec.)	520 (357)	1-[2-methyl-4-(2-methylphenylazo) phenylazo-2-naphthol
Sudan Red 7B	130 (dec.)	535 (372)	N-ethyl-1-[[p-(phenylazo)phenyl]azo]-2-naphthalenamine
Para red	248-252	488 (328)	1-(4-Nitrophenylazo)-2-naphthol

Sudan Dyes in Foods

Chemical Structures of Sudan dyes

Sudan I





Sudan II

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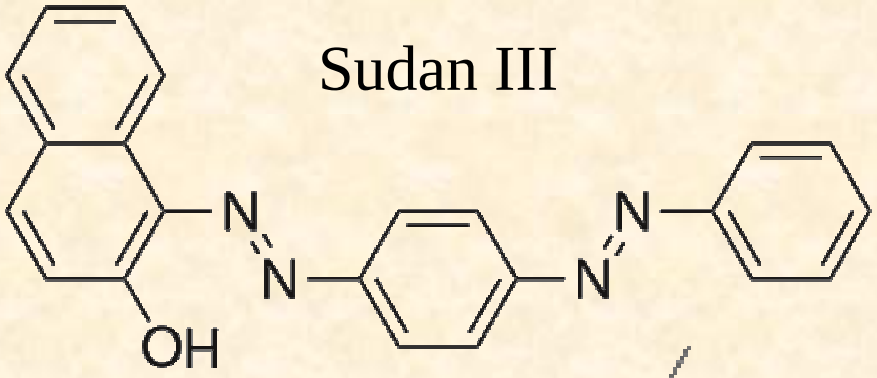
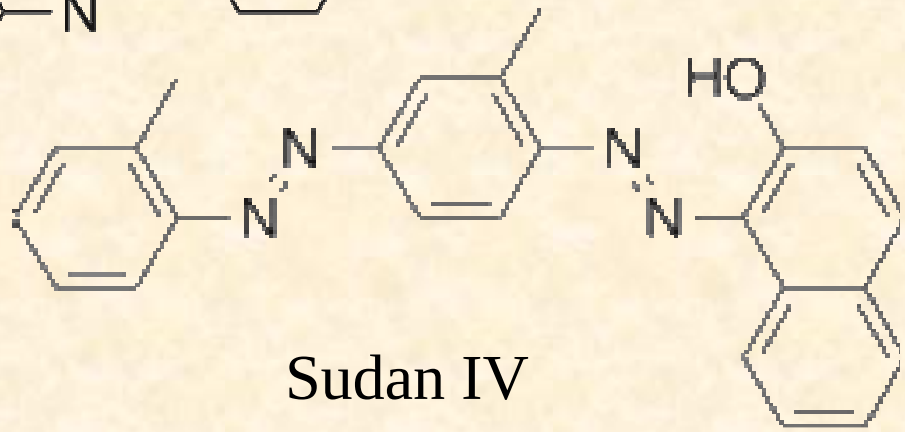
Chemical Structures of Sudan dyes

Sudan III

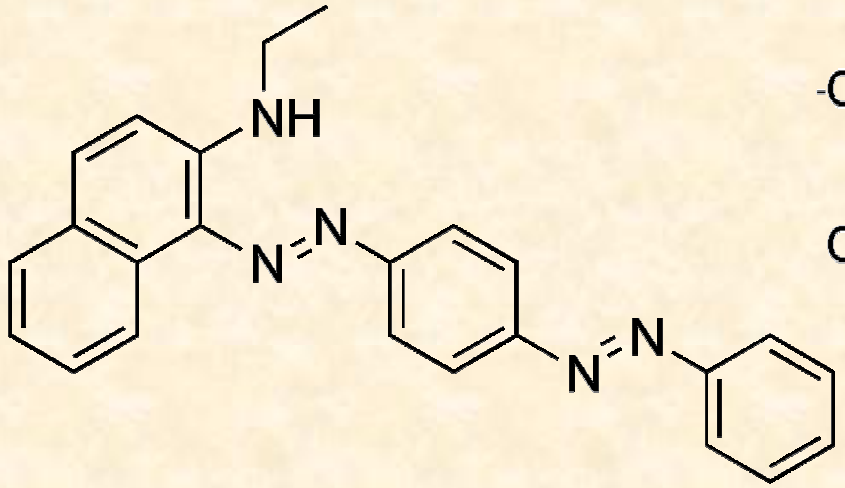




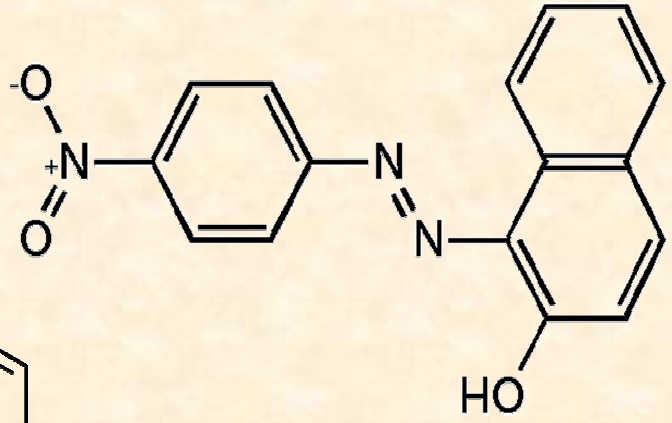
Sudan IV

Sudan Dyes in Foods

Chemical Structures of Sudan dyes



Sudan Red 7B



Para Red

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Sudan dyes – Analytical Methodology

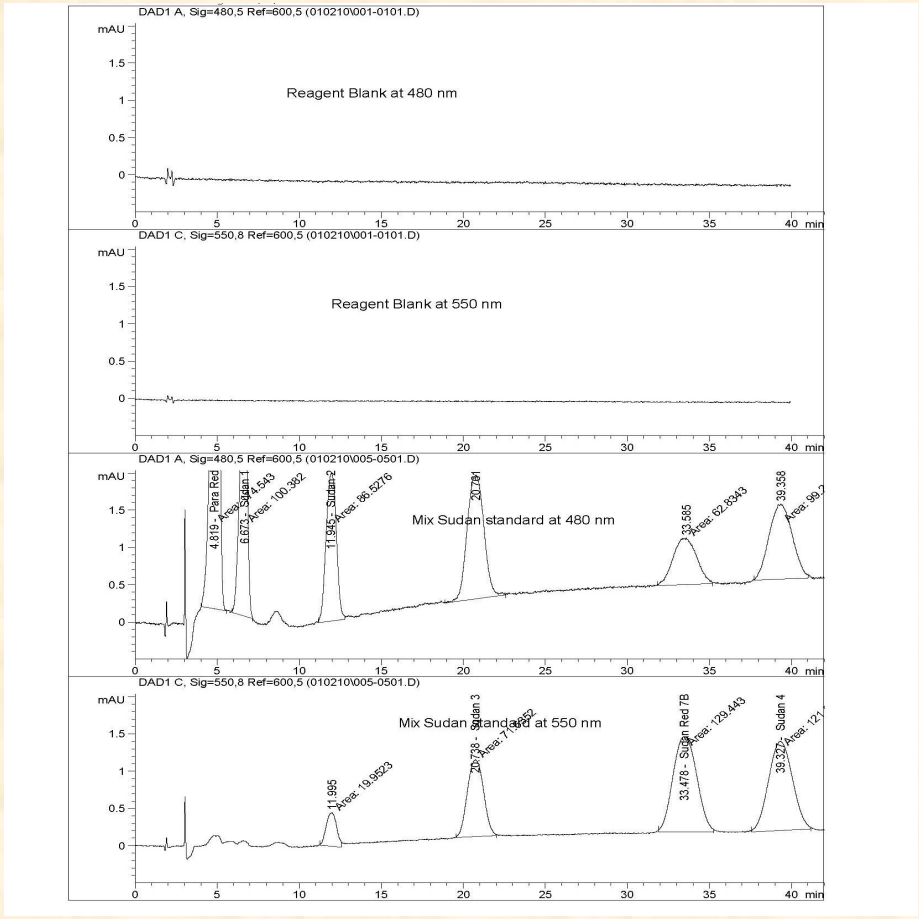
1) Sudan dyes are extracted from sample using mixed solvent (Acetonitrile & Acetone)
2) Sudan dyes in the clear extract are separated by HPLC
   a) Column: Lichrosorb 10 RP C-18 (4.6 mm i.d x 250 mm)
   b) Mobile phase: 10 mM NH_4OAc in water (pH: 3.6) + Acetonitrile at 1.5 mL/min
3) Sudan dyes are detected by PDAD at 480 nm & 550 nm.

Sudan Dyes in Foods

STANDARD CHEMICAL SOLUTIONS

Reagent Blank

Standard Solution (2 mg/L)



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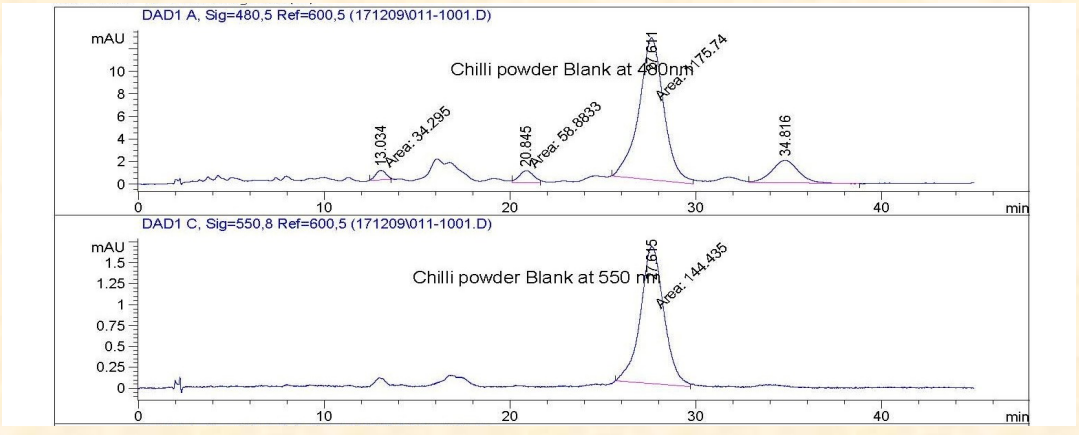
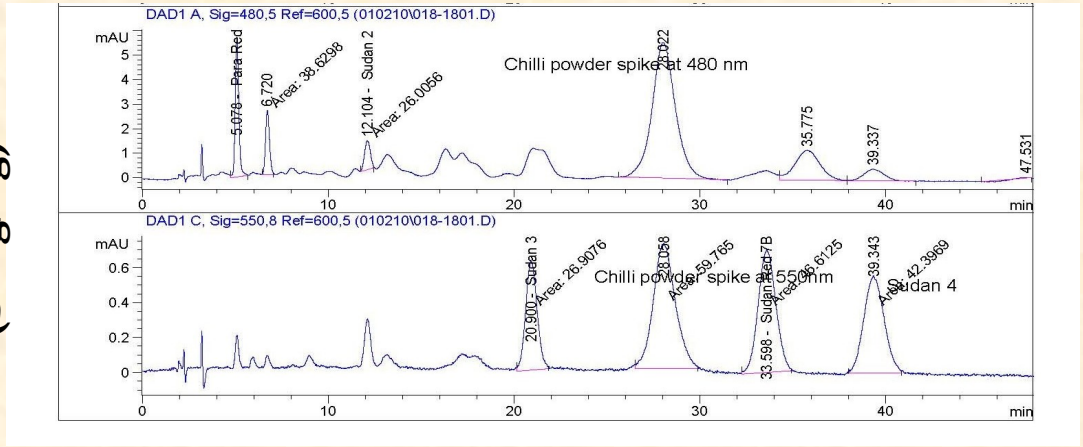
CHILLI POWDER SAMPLE

Pure Sample



Spiked Sample (5 mg/kg)



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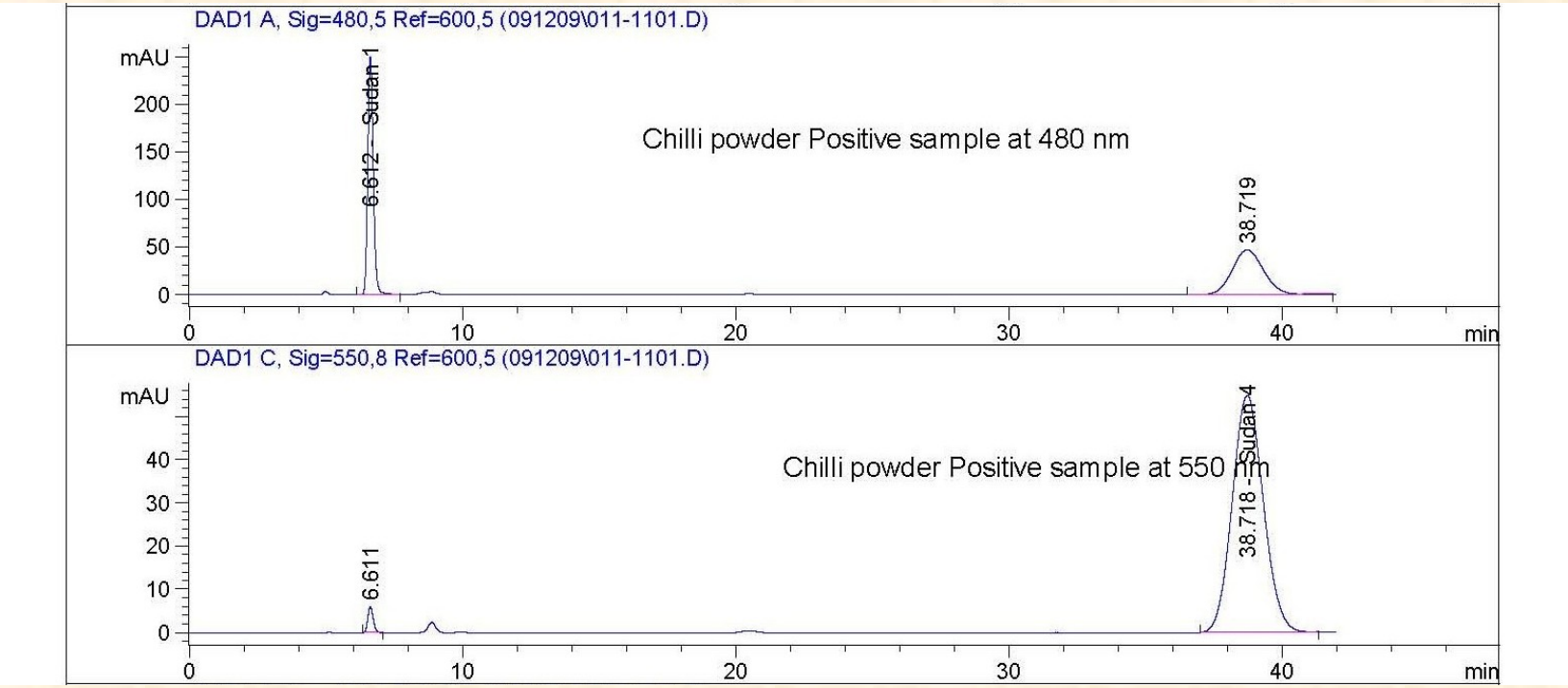
CHILLI POWDER SAMPLE - ADULTERATED



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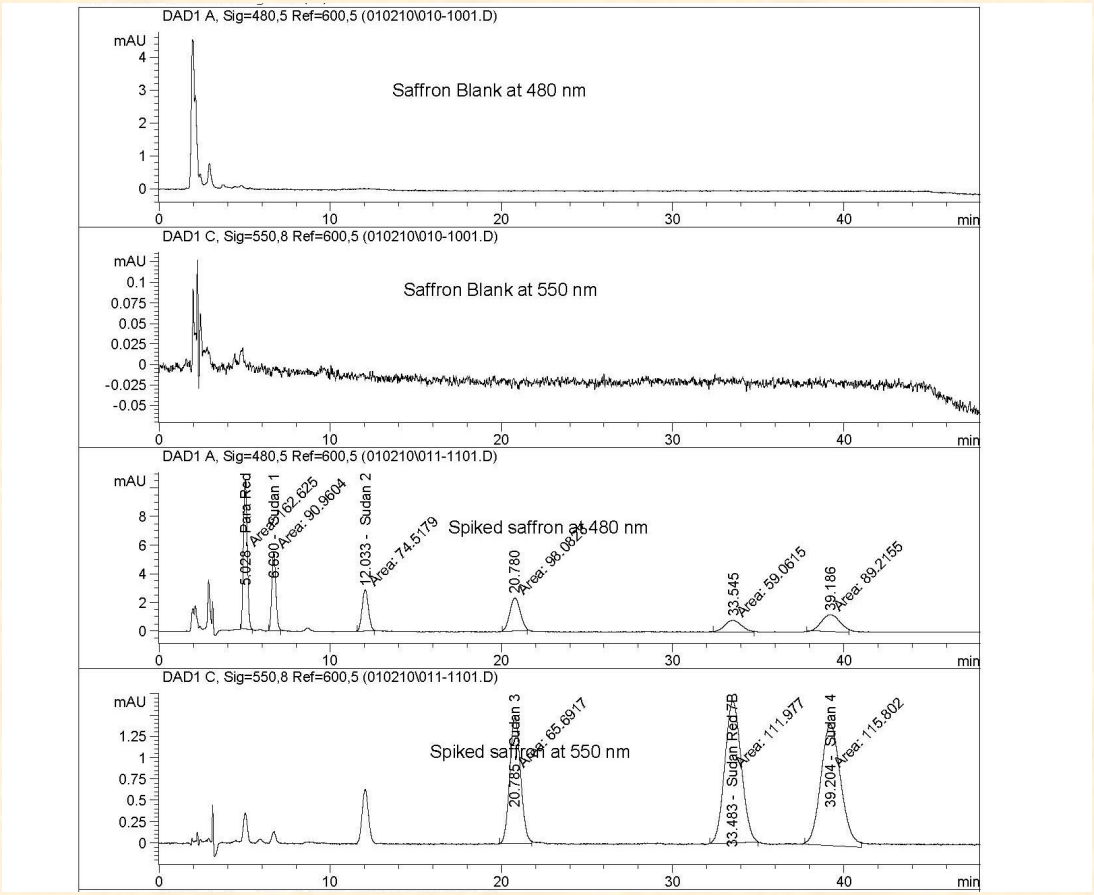
SAFFRON SAMPLE

Pure Sample

Spiked Sample (20 mg/kg)



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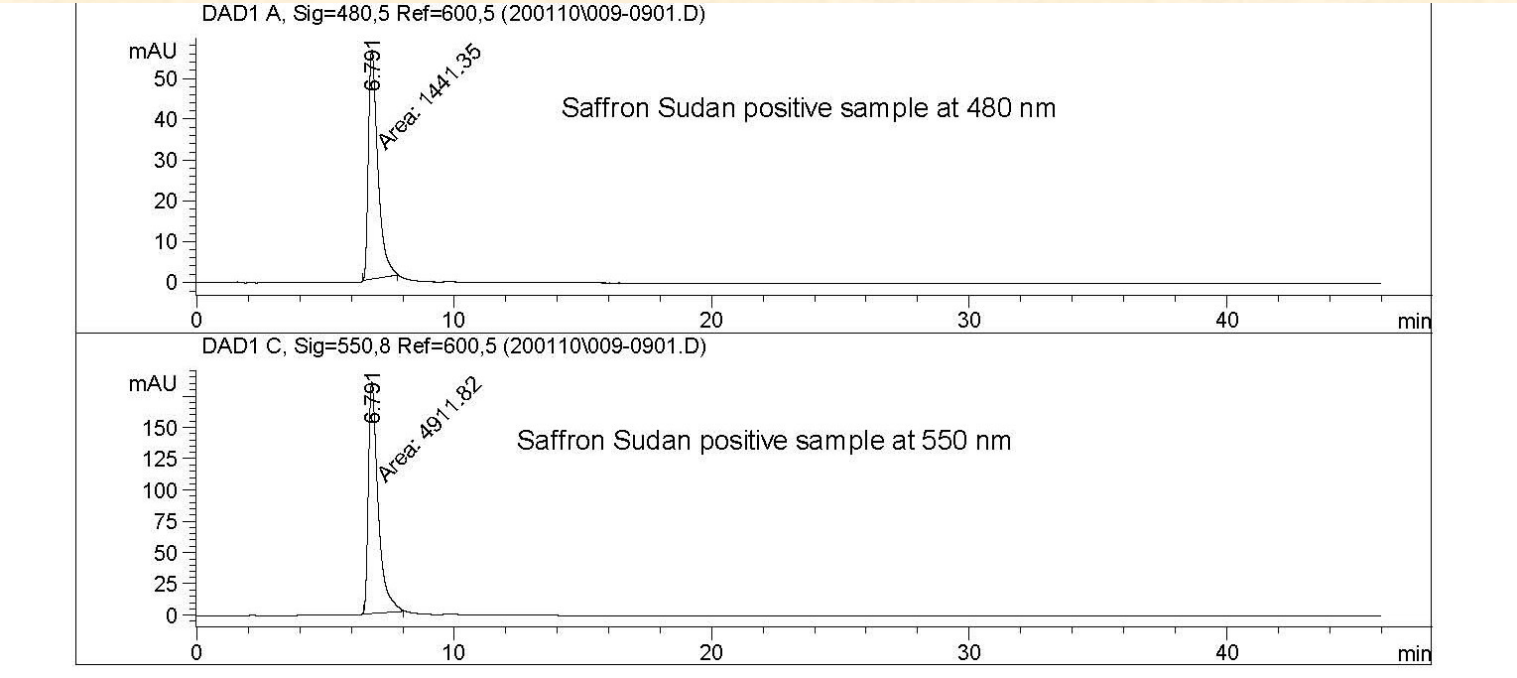
SAFFRON SAMPLE - ADULTERATED



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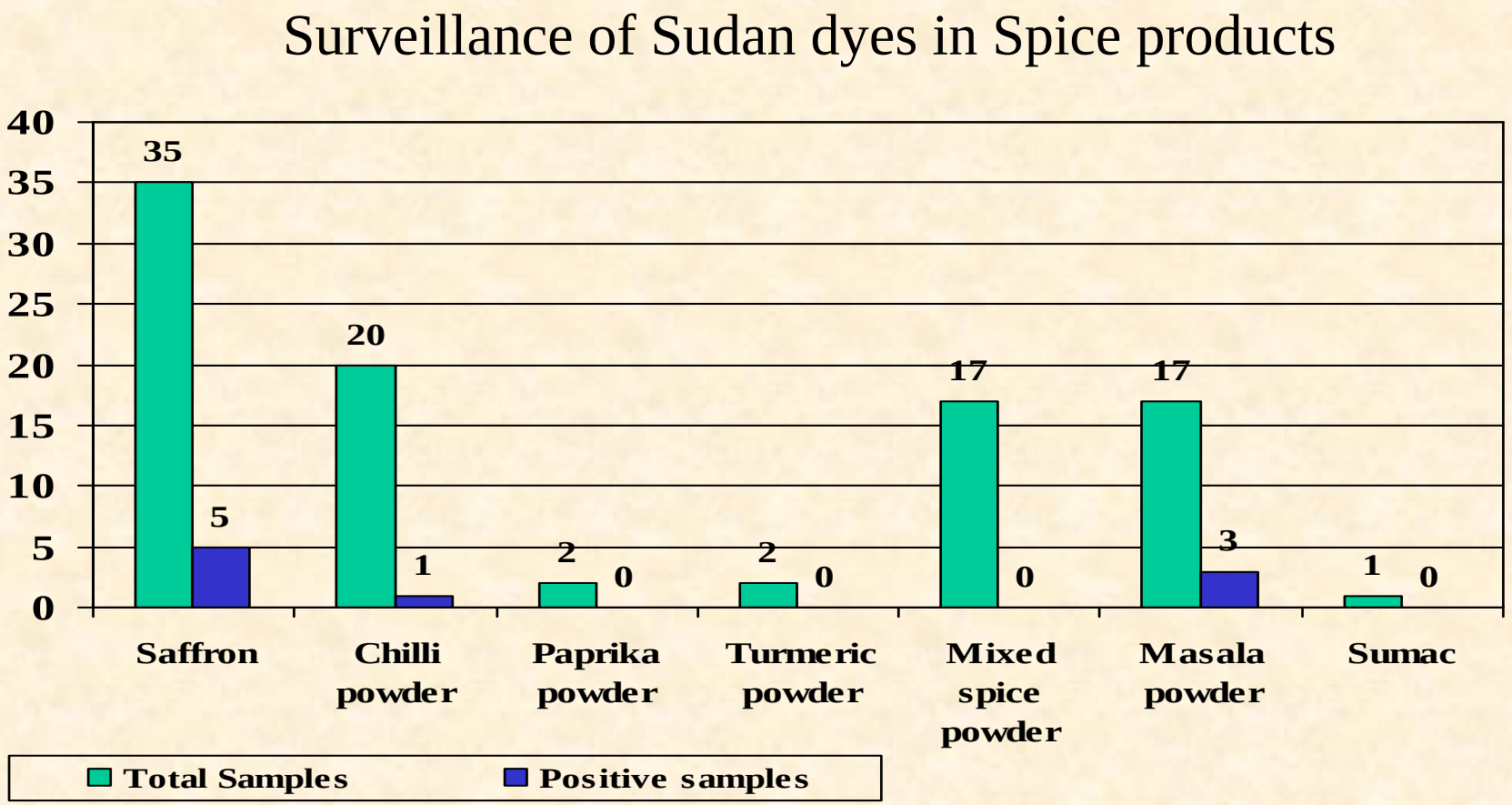
Sudan dyes – Method performance

1) Inter day precision: % RSD – 8
2) Limit of detection: 0.3 mg/kg of Sample
3) Linear range of Calibration graph: up to 20 mg/L with 20 µL injection volume
4) Recovery (for various matrices & in the spike level range of 1 to 20 mg/kg): 70 to 110 %
5) Chilli/Saffron matrix components did not give any peaks close to those of Sudan dyes.

Sudan Dyes in Foods

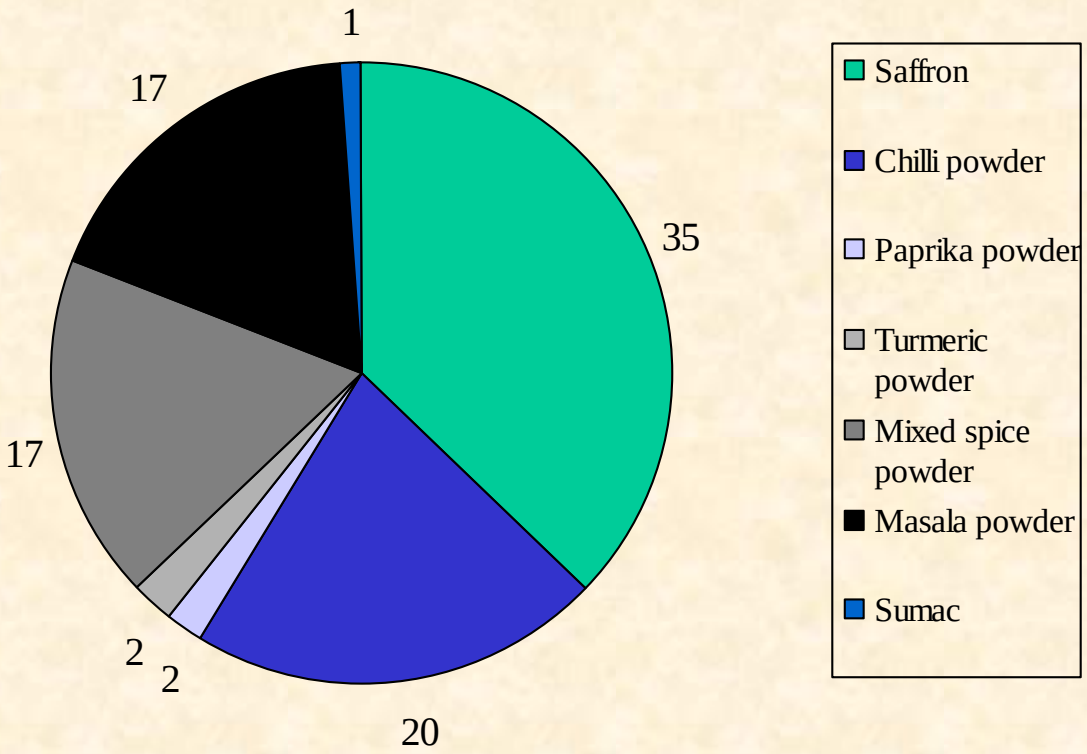
Surveillance of Sudan Dyes in Spice products					
Sl. No.	Name of Material	No. of Samples tested	Positive Samples		
			Number	Dye	Level (mg/kg)
1	Saffron	35	5	Sudan I	1.5 - 250
2	Chilli powder	20	1	Sudan I	1599
				Sudan IV	666
3	Paprika powder	2	0	--	--
4	Turmeric powder	2	0	--	--
5	Mixed Spice powder	17	0	--	--
6	Masala powder	17	3	Sudan I	1.5,3,1063
7	Sumac	1	0	--	--
	TOTAL	**94**	**9**		

Sudan Dyes in Foods



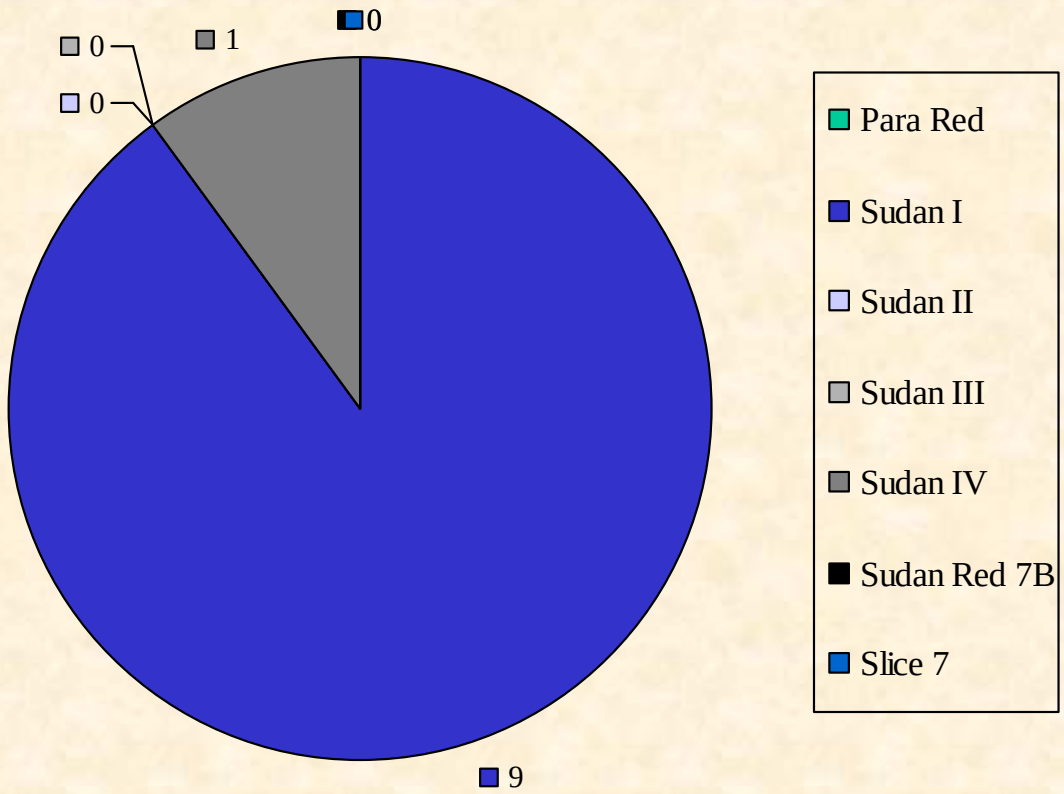
Sudan Dyes in Foods

Surveillance of Sudan dyes in Spice products
- Number of Samples



Sudan Dyes in Foods

Sudan dyes in Spice products – Number of Positive samples



Sudan Dyes in Foods

Conclusions

1) Method standardised at F&ELS is found fit to detect Sudan I – IV, Para red & Sudan Red 7B at levels of current regulatory recommendation.
2) Chilli / Saffron matrix components did not interfere with analytes under consideration
3) Presence of Sudan dyes in some of the samples tested indicates the necessity of continuing this activity.

Sudan Dyes in Foods

Working Group :

Dr. A. G. Krishnamacharyulu &
Mrs. Vaidehi Garimella

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THANK YOU

For your

Cooperation &

Patient listening

-Dr. Gopalakrishna