

# Aspects of flavour restoration – Issues from laboratories view

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WHEN YOU NEED TO BE SURE



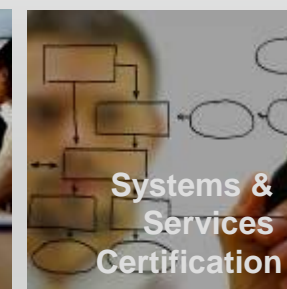
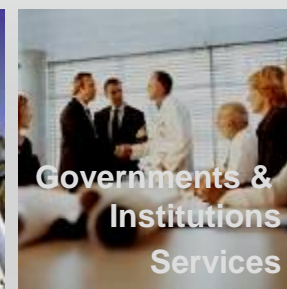
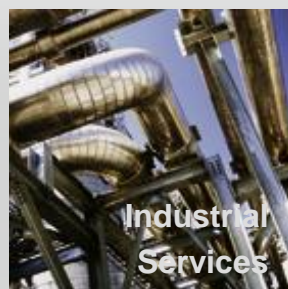
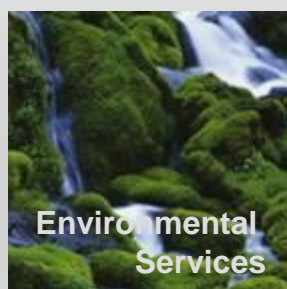
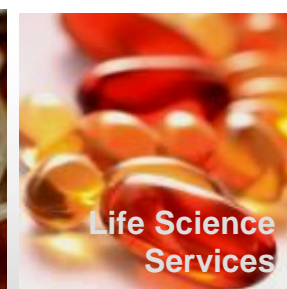
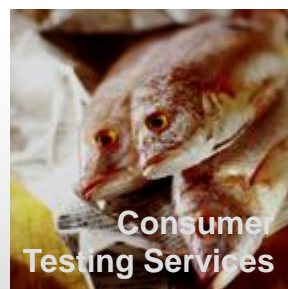
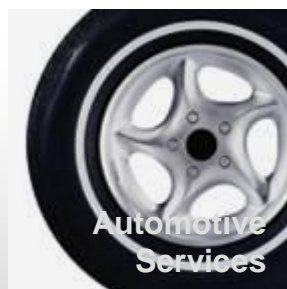
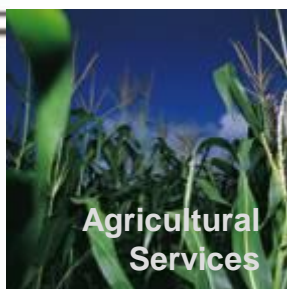
## A BRIEF HISTORY OF SGS



- **SGS - Société Générale de Surveillance**
  - Founded in Rouen (France) in 1878
  - First registration as Société Générale de Surveillance in Geneva 1919
  - More than 59'000 employees worldwide
  - Global network of over 1'000 offices and laboratories in over 140 countries

## BUSINESS APPROACH

BUILDING **TRUST** THROUGHOUT SUPPLY CHAIN



FROM FIELD TO COSTUMER

## SGS GERMANY FACTS & FIGURES

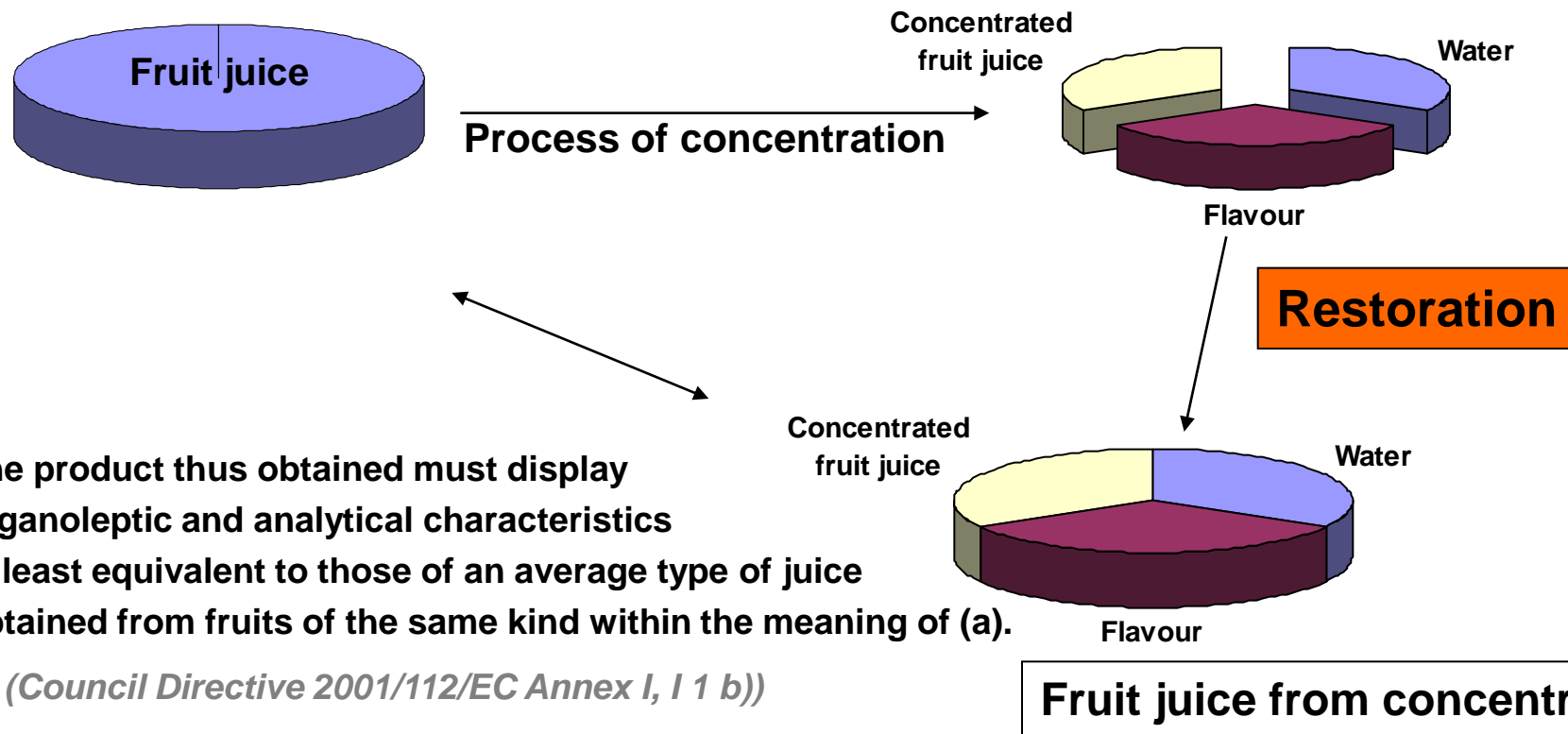


### ■ **SGS Holding Germany**

- Since 1920 in Germany
- Over 2.500 employees all over Germany
- Local network of 34 offices and laboratories
- Holding registered in Taunusstein (Frankfurt)

## **Aspects of flavour restoration – Issues from laboratories view**

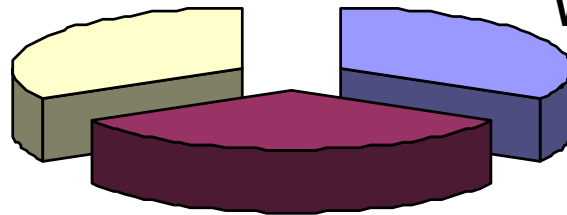
- **Legal aspects**
- **Common considerations**
- **Aspects of aroma analysis**
- **Aspects of apple and orange juice**
- **Outlook**



Concrete analytical values for restored fruit juices from concentrate:  
Commission Directive 2009/106/EC;  
A.I.J.N. CoP

Concrete analytical values:  
- Specific comments on the A.I.J.N. Reference Guidelines (RG)  
- (may be soon Council Directive 98/83/EC)

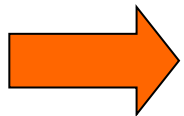
**Concentrated  
fruit juice**



**Water**

**Flavour**

A.I.J.N. Restoration Guideline;  
Specific comments on the A.I.J.N. Reference Guidelines (RG))



**No concrete analytical values  
Evaluation of experts is needed**

**Non Governmental Organisations**

**Official governmental laboratories**

**Private laboratories**

**Supermarkets**

**discounter**

**Flavour producer**

**Fruit juice producer**

**Traders**



**Confusion**



**Demand for harmonized scientifically based specifications**



- The sensory impression is induced by a mixture of sensory-active compounds
- There is a theoretical correlation between substantial composition and virtual impression that has not been found in practice up to now.



**Flavour may be described organoleptically and analytically**

**Both have advantages and disadvantages**

**Both are important**

*Characteristic flavour*

*Sufficient restoration*

*At least equivalent to an average type of fruit juice*

*Maintain essential analytical and organoleptical characteristics*

## Organoleptic

## Analytics

Describes sensory impression

Describes substantial composition

Partial subjective character

Objective

In-house standards

Chemicals are on the world market

Models under construction

Models available

Same results worldwide possible?

Works comparable worldwide



- Liquid extraction methods (e.g. LLE, Kutscher-Steudel)
- Destillative methods (e.g. SDE, SAFE)
- Headspace methods (e.g. static headspace, purge and trap, SPME)
- Every analytical method is a compromise

- Suitable flavour analysis method
- The official method 0.00-106 according to § 64 LFGB is a good framework.
- Minimum requirement is GC/MS
- Suitable flavour parameters
- Sufficient data basis for statistical examinations

**Single substances**  
(e.g. Ethyl butyrate)



**natural variations**

**Sum parameters**  
(e.g. Sum of esters, Aromaindex)



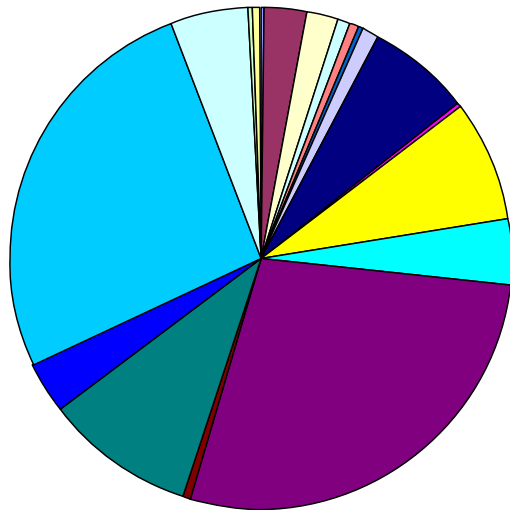
**Sensory important or parameters with indicator function are summarized. Natural variations are „buffered“.**

**Total analysis pattern**



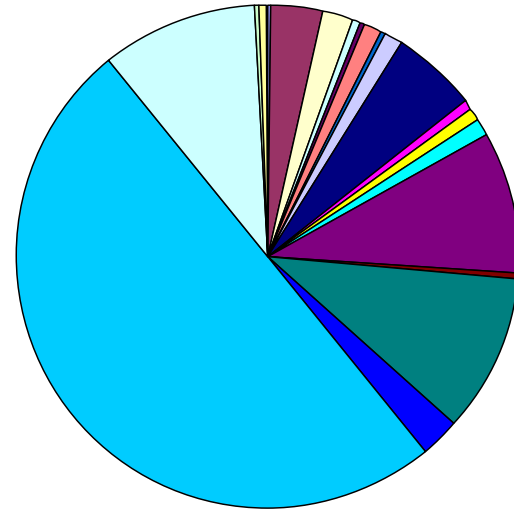
**The analytical pattern is unique for the fruit genus. Adulteration even of single substances or the sum parameters can be detected.**

apple juice 1



- Propylacetat
- Butylacetat
- Summe 2-Methylbutylacetat
- Hexylacetat
- tr-2-Hexenylacetat
- Ethylbutyrat
- Summe Ethyl-2-methylbutyrat
- Hexanal
- trans-2-Hexenal
- Benzaldehyd
- 1-Propanol
- Isobutanol
- 1-Butanol
- 1-Pentanol
- Summe 2-Methylbutan-1-ol
- 3-Methylbutan-1-ol
- 1-Hexanol
- trans-2-Hexen-1-ol
- trans-3-Hexen-1-ol
- cis-3-Hexen-1-ol

apple juice 2





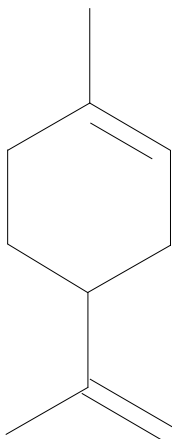
- A lot of analytical data published
- Flavour pattern quite clear
- Only waterphase and concentrate exist
- Concentrate often contains no flavour

- **Aromaindex 150 may be soon official A.I.J.N. criterium**
- **A project group of GDCh (German association of chemists) will soon publish fundamental analytical data on apple juice flavour.**



- A lot of analytical data exist, but very few published
- Flavour pattern quite complex
- There is peel oil, essence oil, waterphase and concentrate
- Concentrate often contains large amounts of flavour
- Scalping

- **Several not harmonised quality criteria on orange juice flavour**
- **Discussions of flavour criteria in the beginning**



**limonene**

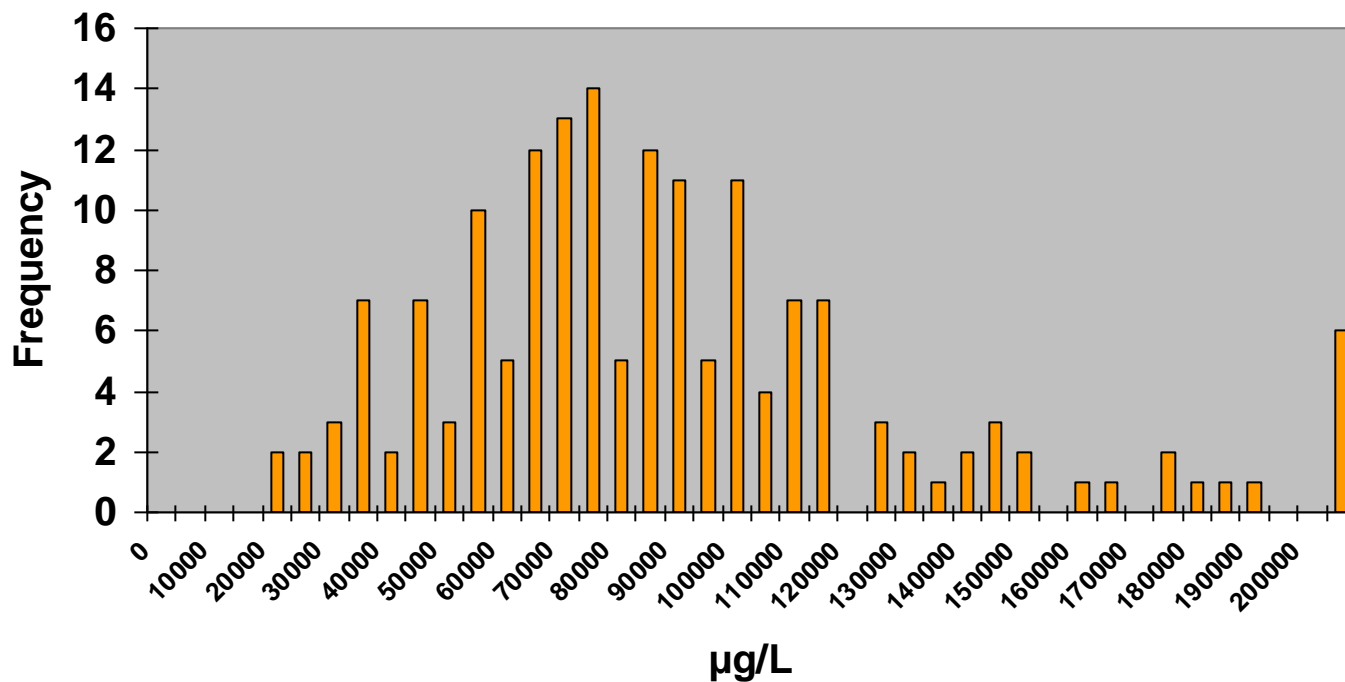
- ~ 95 % in oil-phases (essence and peel)
- Positive for fruity citrus flavour
- Precursor of off-flavour



Good marker for orange oil content (e.g. IFU 45; SDE)

Problem: Scalping depending on type of packaging

## Limonene in orange juices



Samples	168
Mean value	89908
Mean standard deviation	67954
1st percentile	19455
5th percentile	30533
10th percentile	41219
25th percentile	60302
median	78945
75th percentile	100992
90th percentile	142062
95th percentile	175188
99th percentile	310106
NFC	5
from concentrate	163

	OJC	oil-phase	water-phase	OJfC	OJfC	OJfC
				theoretical	real	real
	[µg/L]	[µg/L]	[µg/L]	[µg/L]	[µg/L]	[µg/L]
					PET	Carton
Ethyl butyrate	26	241	48	315	369	330
Ethyl hexanoate	6	29	1	36	37	32
Octanal	206	671	56	933	932	882
Nonanal	45	146	3	194	206	199
Decanal	231	424	2	657	629	546
Dodecanal	78	119	0	197	208	210
alpha-Pinene	419	379	0	798	655	409
Limonene	69142	75765	27	144934	156852	99562
beta-Myrcene	1084	1482	0	2566	2200	1480
Linalool	309	1142	187	1638	2116	2029
alpha-Terpineol	218	166	10	394	694	769
Carvone	57	187	4	248	216	216
Neral	4	192	3	199	5	6
Geranial	6	251	4	261	8	10
Valencene	1806	2471	0	4277	3780	3400
Nootkatone	78	121	0	199	158	142
beta-Caryophyllene	73	84	0	157	104	98
alpha-Caryophyllene	13	19	0	32	28	25

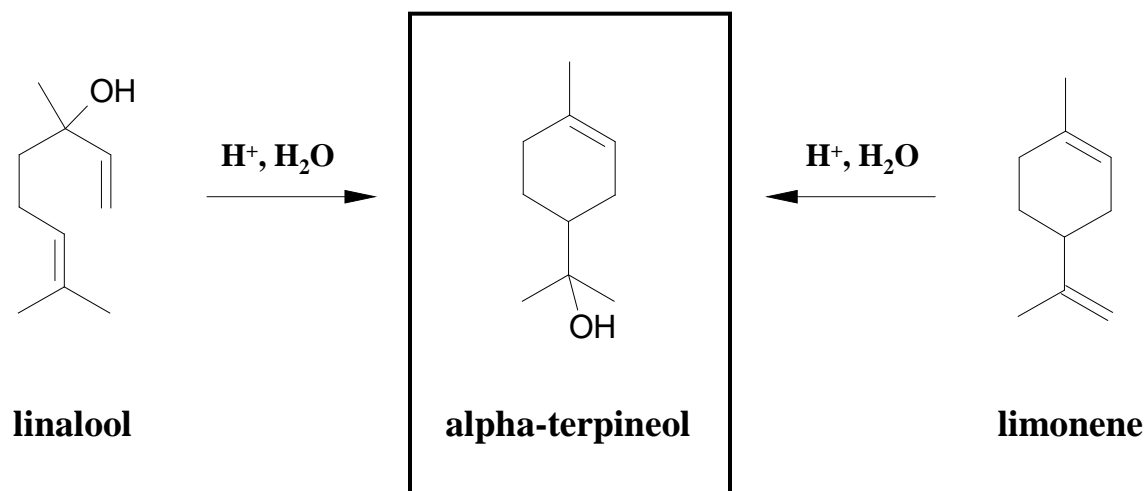


**Scalping of unpolar compounds depends on packaging**

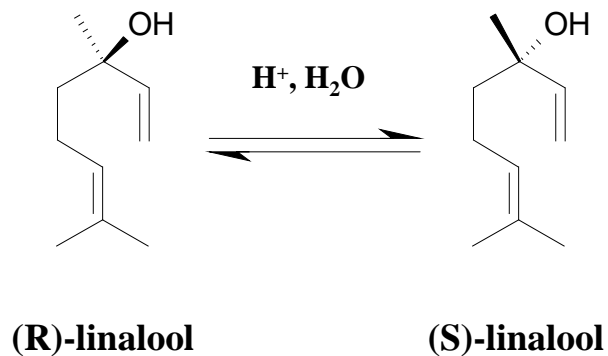
# SGS Scalping in carton packages – model calculation

	Package 1	Package 2	Package 3	Package 4
height [cm]	25	18.5	10	4
width [cm]	10	9	5	2
depth [cm]	6	6	4	0.5
<b>Volume [cm<sup>3</sup>]</b>	<b>1500</b>	<b>999</b>	<b>200</b>	<b>4</b>
<b>Surface [cm<sup>2</sup>]</b>	<b>920</b>	<b>663</b>	<b>220</b>	<b>22</b>
ratio V/S	1.6	1.5	0.9	0.2
Limonene begin [ $\mu\text{g/L}$ ]	150,000	150,000	150,000	150,000
Limonene end [ $\mu\text{g/L}$ ]	100,000	95898	60328	0
Limonene begin [ $\mu\text{g/package}$ ]	225,000	149,850	30,000	600
Limonene end [ $\mu\text{g/package}$ ]	150,000	95,802	12,066	0
loss [ $\mu\text{g}$ ]	75,000	54,048	17,934	600
loss [%]	33.3	36.1	59.8	100
loss limonene [ $\mu\text{g/cm}^2$ ]	81.52	81.52	81.52	81.52

- Characteristic flavour left?
- Packaging suitable?
- Marketable quality?
- Fruit juice according to 2001/112/EC?
- Similar problem with clear lemon juice.



- produced from limonene and linalool dependent on pH and temperature and concentration of precursors
- unavoidable increasing during storage (indicator for storage time)
- regarded as off-flavour (turpentine, lilac; threshold 2 – 3 mg/L)
- interpretation as single component has to be done carefully



- partial racemisation occurs during storage dependent on pH and temperature
- racemisation is independent of any precursors
- indicator of storage time
- helps to interpret alpha-terpineol content

Restoration of orange juice from concentrate

SGS – Institut Fresenius recommendation

In regard to organoleptical aspects and shelflife requests

- limonene > 60000 µg/L (< 120000 – 180000?)
- alpha-terpineol < 1500 µg/L  
(consideration of enantiomeric ratio of linalool)
- ethyl butyrate > 200 µg/L
- organoleptically characteristic flavour



This recommendation is based on German market demands

## Annex I; I Definitions 1. a) Fruit juice

The fermentable but unfermented product obtained from the edible part of fruit (...) having the characteristic colour, **flavour and taste typical of the juice of the fruit from which it comes.**

 FTNJ

Flavour, pulp and cells obtained by suitable physical means **from the same species of fruit** may be restored to the juice.

 FTNF

## Restoration

Introduction of aromas and flavours are allowed to restore the level of these components **up to the normal level** attained in the same kind of fruit.

## What changes / Possible effects

### Fruit juice (NFC)

- Restoration of flavour is allowed



- Correction of flavour deficits in raw material (disadvantageous climate, but also unripe fruits and long term stored juices)
- labelling „direct pressed“?
- misleading of consumer possible?

## Annex I; I Definitions 1. b) Fruit juice from concentrate

The product obtained by reconstituting concentrated fruit juice defined in part I.2 with potable water (...).

Flavour, pulp and cells obtained by suitable physical means from the **same species of fruit** may be restored to the juice.



**FTNF**

The juice is prepared by suitable processes, which **maintain** the **essential** physical, **chemical, organoleptical** and nutritional **characteristics of an average type of juice of the fruit from which it comes.**



**FTNJ**

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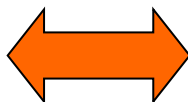
## Annex I; I Definitions 2. Concentrated fruit juice

The product obtained from fruit juice of one or more species by the physical removal of a specific proportion of the water content.

## Possible interpretations

### Fruit juice from concentrate

Optional restoration



- Characteristic flavour
- Maintain essential chemical and organoleptic characteristics

### A.) Characteristic flavour is mandatory



- restoration of flavour is no more optional, but also mandatory
- actual situation does not change

## Possible interpretations

### Fruit juice from concentrate

#### B.) Really optional flavour restoration



- characteristic flavour of the fruit juice is also optional
- compliant to image of fruit juice from concentrate?
- compliant to quality control standards of the product?
- different production lines possible (without labelling):
  - one „quality line“ with flavour
  - one „economic line“ without flavour
- fair competition? Misleading of consumer possible!
- Whose benefit is it?

## Possible interpretations

### Fruit juice from concentrate

	Interpretation	
	A	B
misleading of consumer possible?	no	yes
benefit on consumer protection	yes	no
benefit on product image?	yes	no
benefit on producer image?	yes	no
effect on prices	remaining	lower
better quality?	yes	no
fairer competition	yes	no
adaption of technological progress?	no	no
quality factors established?	yes	no

# Annex I; II Authorised Ingredients, Treatments and Substances

## 2. Authorised ingredients

Flavour, pulp and cells restored to fruit juice, nectars, fruit juices from concentrate and concentrated fruit juices **may be recovered from the same species of fruit.**



What means „may“?

Is orange flavour in apple juice o.k.?

## Annex II; 4. Flavour

Without prejudice to Regulation (EC) No 1334/2008, flavours for restoration are **obtained during processing of the named fruit** by applying **suitable physical processes**. These physical processes may be applied to **retain, preserve or stabilize the flavour quality** and include in particular squeezing, extraction, distillation, filtration, adsorption, evaporation, fractionation and concentration.

Flavour is obtained from the **edible parts of the fruit**; however it could also be cold pressed oil from citrus **peel** and compound from the **stones**.



FTNF

Which processing? Fruit juice processing or general?

Why cold pressed oil, when distillation is allowed?

- **Restoration of flavour is a benefit for fruit juices from concentrate**



- **Harmonised criteria for flavour restoration**
- **Controllable quality**
- **More transparency**
- **Fairer competition**

### 3.2 QUALITY CRITERIA

The fruit juices and fruit nectars **shall have the characteristic** colour, aroma and **flavour of juice from the same kind of fruit from which it is made.**

### 3.3 AUTHENTICITY

Authenticity is the **maintenance** of the product's **essential** physical, **chemical**, **organoleptical**, and nutritional characteristics of the fruit(s) from which it comes.

### 3.4 VERIFICATION OF COMPOSITION, QUALITY AND AUTHENTICITY

Fruit juices and nectars should be subject to **testing for authenticity, composition, and quality where applicable and where required.**

The verification of a sample's authenticity / quality can be assessed by comparison of data for the sample, generated using appropriate methods included in the standard, with that produced for fruit of the same type and from the same region, allowing for natural variations, seasonal changes and for variations occurring due to processing.

**Thank you for attention**

**WHEN YOU NEED TO BE SURE**

