

Electrochemical Sensors and Instruments for Environmental Monitoring, Food Quality and Medical Diagnostics

- **Prof. Kh. Brainina**
- **Urals State University of Economics, www.usue.ru**
- **IVA Ltd., Russia, www.iva.usue.ru**
- **E-mail: baz@usue.ru**



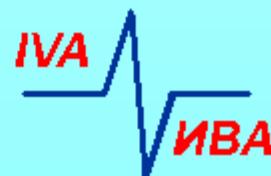
Goals: safety and improvement of health

Factors to be monitored:

- Environmental pollution;
- Oxidative stress;
- Diagnostically important compounds;
- Infections

Research Objectives

- Development of a portable battery - powered analyzer outfitted with disposable sensors for the determination of copper, lead and cadmium concentrations.
- Development of an automatic flow - through system outfitted with a long - lived sensor for remote monitoring applications.
- Development of Antioxidant/oxidant activity (oxidative stress) meter.
- Development of sensors for human body liquids analysis.



Why Electrochemical Methods?

- ✓ Detection limit at sub-ppb level
- ✓ Low price of instruments
- ✓ High selectivity
- ✓ Low matrix effect
- ✓ Possibility of simultaneous determination of several species
- ✓ Possibility of on-site and on-line analysis

Development of a portable electrochemical device for measuring heavy metals

❖ Features of Device

- Portable device with battery or power circuit supply
- Disposable graphite containing strip-sensors for determination of heavy metals in laboratory and field.

❖ Three-stage analytical process, including:

- Electrochemical pretreatment of samples to eliminate interference from organic matter (patent: RF N 2150108 from 11/17/98)
- Accumulation of the analytical metals on electrode surface
- Measurements





ГОСУДАРСТВЕННЫЙ
КОМИТЕТ РОССИЙСКОЙ ФЕДЕРАЦИИ
ПО СТАНДАРТИЗАЦИИ И МЕТРОЛОГИИ
(ГОССТАНДАРТ РОССИИ)

СЕРТИФИКАТ

об утверждении типа средств измерений

PATTERN APPROVAL CERTIFICATE
OF MEASURING INSTRUMENTS

RU.C.31.005.A № 9953

Действителен до
"01" мая 2006 г.

Настоящий сертификат удостоверяет, что на основании положительных результатов испытаний утверждён тип анализаторов инверсионных

вольтамперметрических ИВА

наименование средства измерений

наименование предприятия-изготовителя

ООО «НПВП «ИВА», г. Екатеринбург

который зарегистрирован в Государственном реестре средств измерений под

№ 15168-96 и допущен к применению в Российской Федерации.

Описание типа средства измерений приведено в приложении к настоящему сертификату.

Заместитель Председателя
Госстандарта России

В.Н.Крутиков

2001 г.

Продлен до

200 г.

Заместитель Председателя
Госстандарта России

" " 200 г.



ГОССТАНДАРТ РОССИИ
ГУ «УРАЛЬСКИЙ ЦЕНТР СТАНДАРТИЗАЦИИ, МЕТРОЛОГИИ
И СЕРТИФИКАЦИИ - УРАЛТЕСТ»

ЛИЦЕНЗИЯ № 142 И,Р,П

На изготовление, ремонт и продажу средств измерений

Выдана ООО НПВП "ИВА", г. Екатеринбург

Владелец лицензии несет ответственность за нарушение условий и требований лицензирования в соответствии с действующим законодательством Российской Федерации.

ОБЛАСТЬ ЛИЦЕНЗИРОВАНИЯ :

- анализаторы инверсионные вольтамперметрические ИВА.

Лицензия действительна
с «01» 11. 2001 г. по «01.» 05. 2006 г.



Директор УРАЛТЕСТ

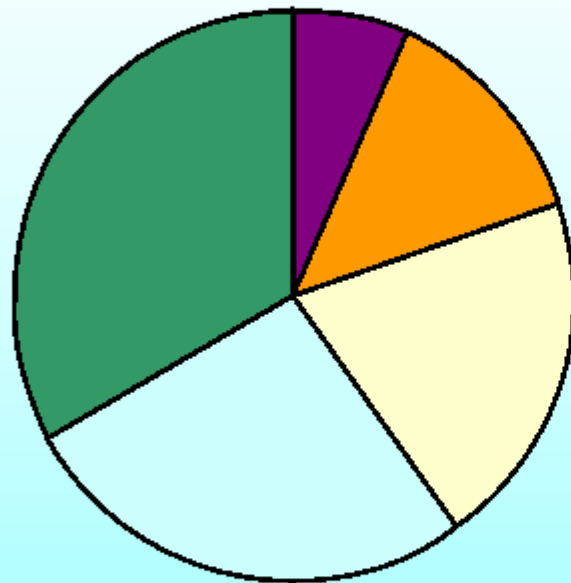
В.Н.Суряков

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Maximum permissible concentrations and detection limits of device

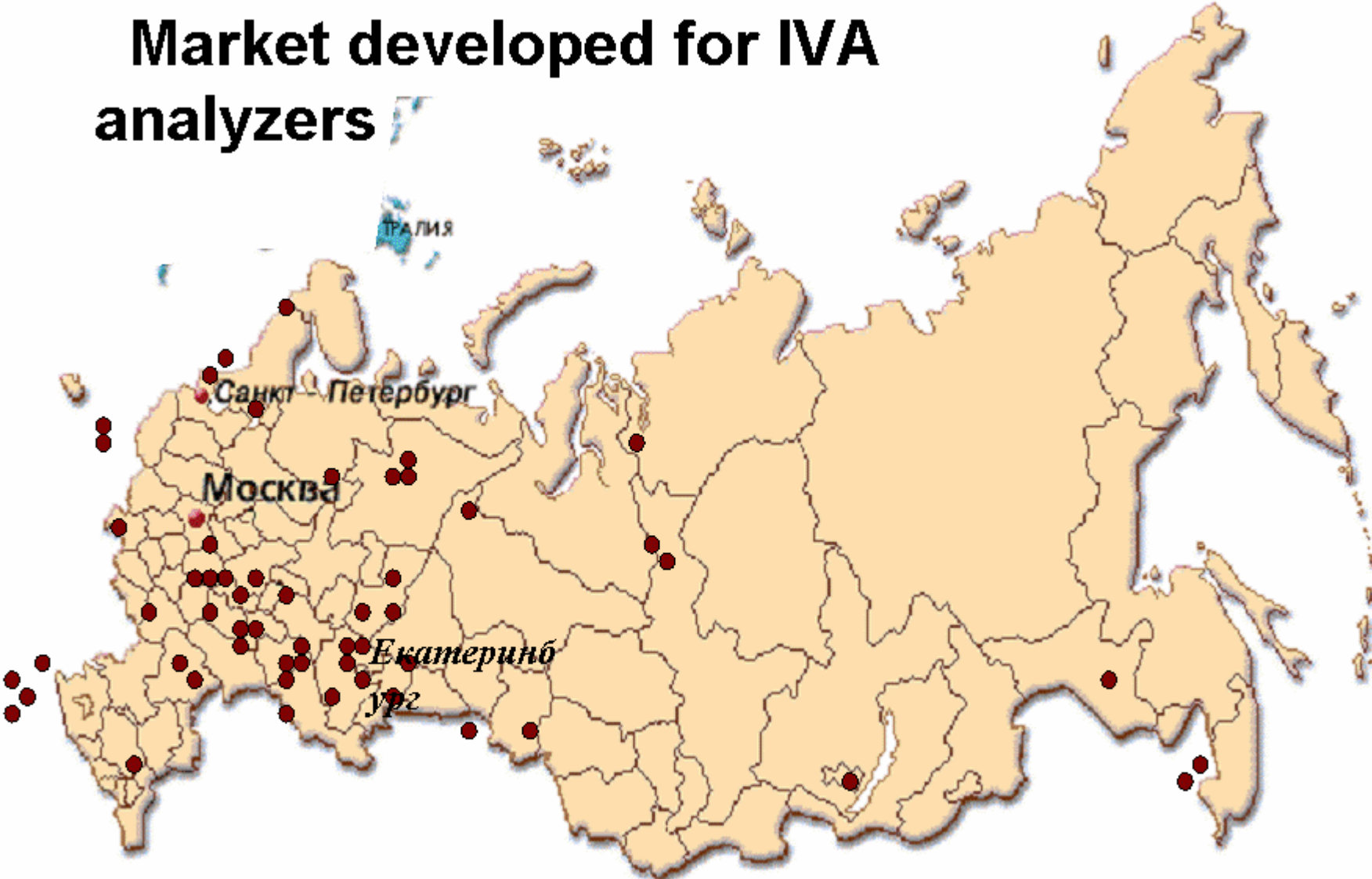
| Element | Maximum permissible concentration in tap water (mg/l) | | | Maximum permissible concentration in fish producing pools (mg/l) | Detection limit (mg/l) |
|-----------|---|-------------|--------------|--|---------------------------------------|
| | Russia | USA | WHO | Russia | |
| Cd | 0.001 | 0.01 | 0.005 | 0.005 | 0.001 |
| Mn | 0.1 | 0.05 | 0.05 | 0.1 | 0.005 |
| As | 0.05 | 0.05 | 0.05 | 0.05 | 0.005 |
| Cu | 1.0 | 1.0 | 3.0 | 0.001 | 0.001 |
| Ni | - | - | 0.05 | 0.001 | 0.001 |
| Pb | 0.03 | 0.05 | 0.05 | 0.1 | 0.001 |
| Fe | 0.3 | 0.3 | 0.2 | 0.3 | 0.002 <i>(in sea water)</i> |
| Zn | 5.0 | | 0.1 | 0.01 | 0.01 |

Consumers: Market for IVA Analyzers



- 1 Industry
- 2 Universities
- 3 Hydrometeorology
- 4 Water supply
- 5 Pollution control

Market developed for IVA analyzers





Computer-aided flow-through discrete analyzer type IVA-7



- ❖ IVA-7 is multifunctional one. It can be used in hydrochemistry, environmental monitoring, processing lines.
- ❖ It is designed for measuring of copper, lead, cadmium, zinc, nickel, chromium, chloride-ions concentration, pH, red-ox potential
- ❖ Option for monitoring chlorine/ozone and its derivatives can be added.
- ❖ System has been developed and fabricated for automatic analysis of waste water of Chelyabinsk zinc-plating facilities

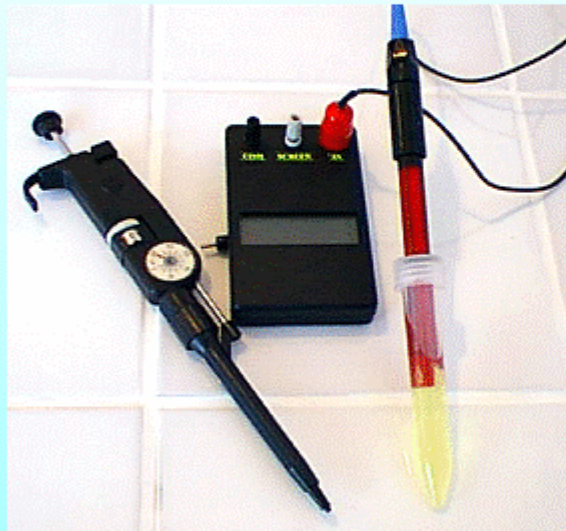
Antioxidant/oxidant Activity Meter

❖ **Evaluation of antioxidant state of human body for early diagnostic of health disorder.**

❖ **Detection of oxidative stress as a result of irradiation, lack of vitamins and antioxidants in the body, stress in the surgical and hemodialysis processes**

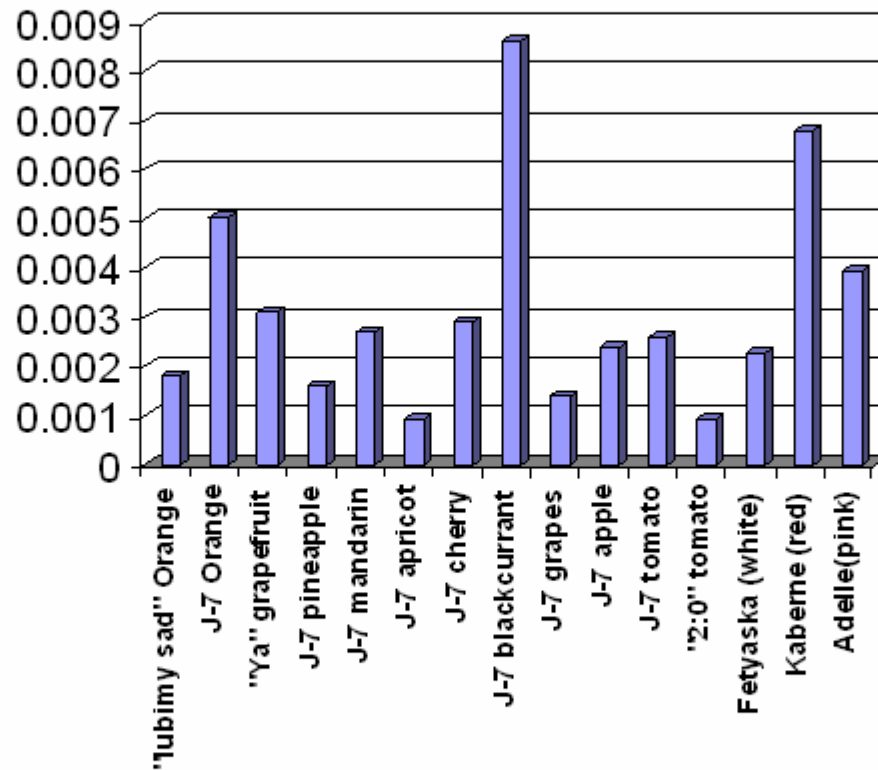
❖ **Evaluation of antioxidant activity of food (juices, beer, wine, tea, coffee, etc.) and bioactive nutrients**

❖ **Monitoring of water chlorination/ozonation process.**



AOA of Juices & wines

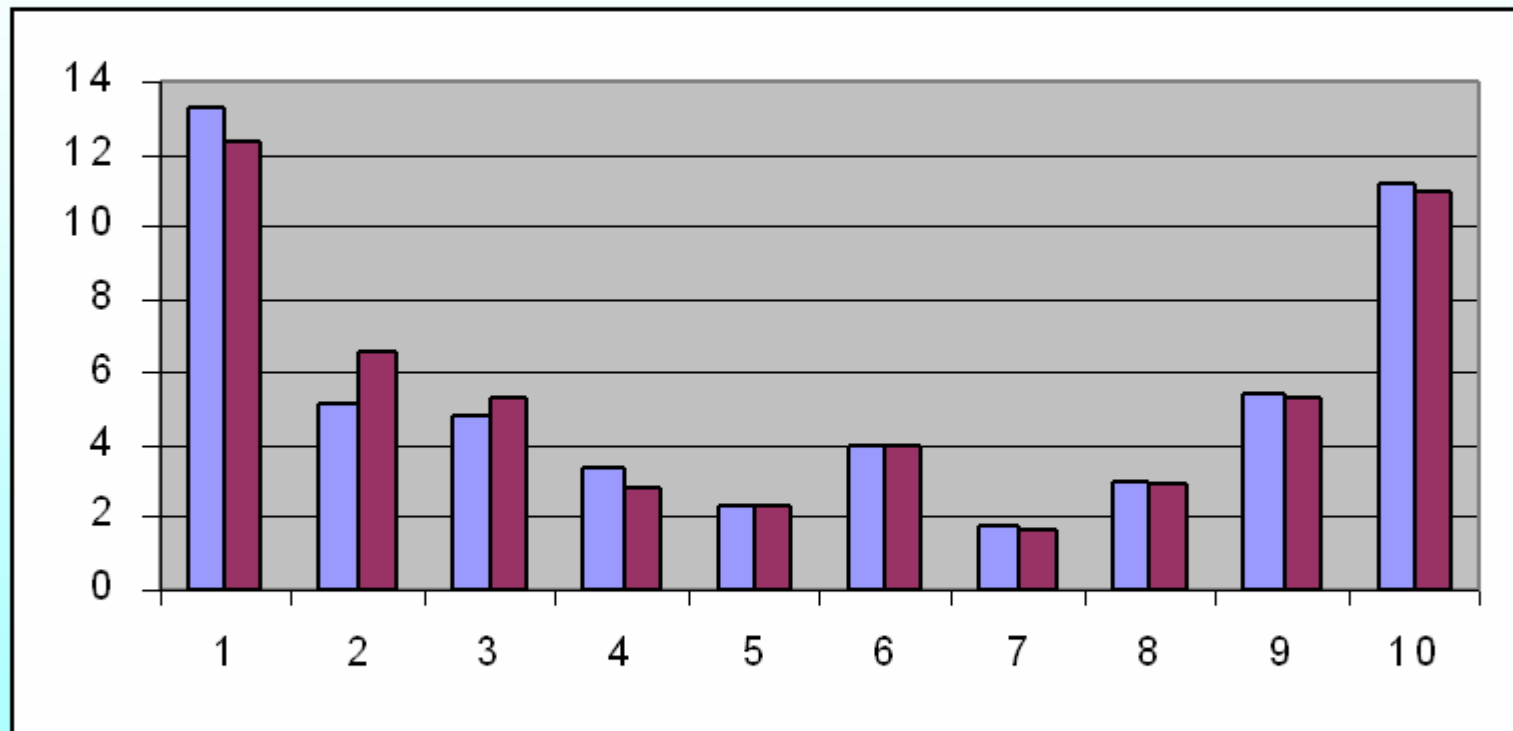
AOA, mEq/L



Non-enzymatic Urea Sensor

- ❖ Based on solid phase catalytic reaction - electrochemical (cyclic voltammetry or chronoamperometry) response is measured
- ❖ Consists of thick film graphite electrode produced by “IVA” Ltd.
- ❖ Sensor Electrode contains catalytic system immobilized on its surface or in the bulk of conducting layer.
- ❖ More stable than enzymatic sensors

Variation of urea concentration in serum (Different patients)



- Urea, mM (enzymatic sensor)
- Urea, mM (non enzymatic)

Seeking Collaboration...

- ❖ **Development of an automatic flow-through discrete system for remote control of water quality for:**
 - Determination of concentrations of toxic elements (Cu, Pb, Cd and Zn)
 - Determination of the oxidants (chlorine and ozone) in water
 - Measurement of pH
- ❖ **Antioxidant/oxidant Activity Meter for:**
 - Evaluation of Antioxidant activity (Oxidative Stress) in human body fluids
 - Antioxidant activity of food, nutrients and others determination
 - Determination of oxidants in wastes, water pools, chlorinated/ozonated waters
- ❖ **Sensors and methods for medical diagnostics:**
 - Nonenzymatic urea sensor
 - Metal labeled immunosensor
 - Thiol/disulphide ratio in human body fluids determination
 - Trace metals in human body fluids determination

IVA Ltd. Contact Information

Scientific Leader: Dr. Kh. Brainina

Address: 8th of March St. 62, 620219
Ekaterinburg, Russia.

Phone/Fax: + 7 343 257 2415

E-mail: baz@usue.ru, hdm@usue.ru

Website: www.iva.usue.ru

