Application Bulletin

Metrohm

Of interest for:
Pharmaceuticals,
food analysis

No. 213/1 e

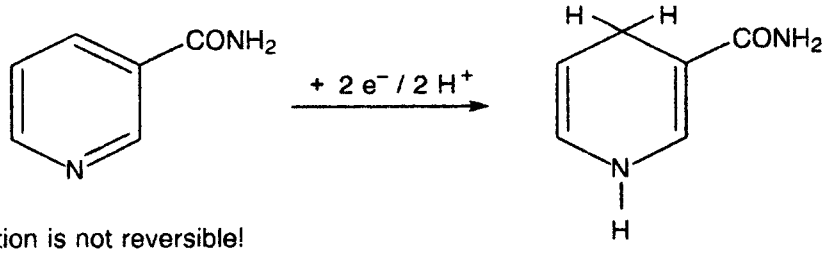
Polarographic determination of nicotinamide

Summary

- This work is one of a series of Application Bulletins published at varying intervals for the polarographic determination of vitamins. The determination of nicotinamide, a vitamin of the B series, is described. Instructions for the determination in solutions (e.g. fruit juice), vitamin capsules and multivitamin tablets are given. The linearity range of the determination is also specified. The limit of detection is ca. 1 µg nicotinamide / 20 mL cell volume.

Theory

- Following Jacobsen and Thorgesen [3], nicotinamide is reduced at the DME according to the following scheme:



This reaction is not reversible!

Apparatus

- 2.646.003X VA Processor with 2.647.0020 VA Stand or
  2.506.0010 Polarecord or 2.626.0010 Polarecord with 2.663.002X VA-Stand

Reagents

(Except for the NaOH, these should be freshly prepared daily.)

- **Primary solution:** 1% v/v tetramethylammonium hydroxide (TMAOH).
  A 25% TMAOH solution (8 mL) (or 20 mL of a 10% solution) is pipetted into a 200 mL volumetric flask and this is filled to the mark with dist. water.
- **Extraction solution:** c(NaOH) = 0.1 mol/L
  4g/L NaOH in H_2O dist.
- **Standard, stock solution:** Ca. 2 g nicotinamide are dried overnight in a desiccator. A sample (250.0 mg) is weighed into a 250 mL volumetric flask, dissolved in dist. water and the flask filled to the mark.
- **Standard, working soln:** This is prepared as needed from the stock solution by dilution with dist. water.

Sample preparation

- **Solutions**
  Solutions (injection solutions, fruit juices, etc.) are adjusted to a pH of ca. 10...12 with NaOH and filtered if need be.
- **Vitamin capsules**
  The contents of 10 ... 20 capsules are weighed and mixed. The average weight is calculated and this (average capsule content) is weighed into a beaker. Extraction solution (20 mL) is added and extraction performed for 20 min on a water bath at 40°C with stirring. After cooling, the mixture is rinsed into a 250 volumetric flask with dist. water, the flask is filled to the mark and the contents thoroughly mixed. The flask contents are then allowed to settle for at least 20 min.

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Sample preparation *(continued)*	▸ **Vitamin tablets (multivitamin tablets)** 10 tablets are weighed to obtain the average weight and then pulverized (grinder, mortar, etc.). The average weight of a tablet is weighed into a beaker and the procedure described for vitamin capsules then followed.
Method	▸ Sample solution (1.5 ... 10 mL), which can contain 50 ... 500 µg nicotinamide, is pipetted into a polarographic vessel, 10 mL primary solution added and the solution made up to 20 mL with dist. water if need be. ▸ After deaeration with nitrogen, the DP polarogram is recorded (amplitude ca. –40 mV to –50 mV) at the DME between –1.4 V and –1.9 V. The peak potential of nicotinamide is at ca. –1.70 V. ▸ The content is determined by duplicate standard addition. It must be ensured that the concentration of nicotinamide in the cell, including that due to the standard additions, does not exceed the linearity range. ▸ ***Figs. 1*** to **5** show the parameter settings at the 646 VA Processor, ***Fig. 6*** and **7** an example of a nicotinamide determination.
Linearity	▸ ***Fig. 8*** and **9** show graphs nA/µg nicotinamide. They are intended to illustrate the approximate slope of the curves and should not be regarded as calibration curves.
Remarks	▸ Optimum values are obtained when 50 ... 500 µg nicotinamide are present in the polarographic vessel (can be adjusted using the sample size). ▸ It is essential to use the DME as working electrode. With the SMDE lower sensitivities are obtained. The SMDE is also more susceptible to disturbances in the alkaline electrolytes (pH ca. 12.8) used.
Literature	▸ Dewjatnin, W.A. / Kuznetzowa, L.A. *Polarographic determination of vitamins B-1, B-2 and nicotinamide in mono- and polyvitamin preparations.* Med. Prom. USSR 58, (1964) 58-60 (in Russian) Ref: Electroanal. Abstr. 5, (1967) 43 ▸ Göbbeler, K.H. / Breinlich, J. *Quantitative, wechselstrompolarographische Simultanbestimmung von Vitaminen der B-Gruppe.* Pharm. Ztg. 48, (1972) 1859-1862 ▸ Jacobsen, E. / Thorgersen, K.B. *Electroreduction and pulse-polarographic determination of nicotinamide in multivitamin tablets.* Anal. Cim. Acta 71, (1974) 175-184 ▸ Moore, J.M. *Polarographische Schnellanalyse von Nikotinamid in pharmazeutischen Präparaten.* J. Pharm. Sci. 58, (1969) 1117-1120 (in English) Ref: Fresenius, Z. Anal. Chem. 254, (1971) 159 ▸ Söderhjelm, P. / Lindquist, J. *Electrochemical assay of thiamine, riboflavine, pyridoxine, nicotinamide and ascorbic acid in pharmaceutical preparations.* Acta Parm. Suec. 13, (1976) 201-212 ▸ Taira, A.Y. *Polarographic determination of niacinamide in multivitamin preparations.* J. Assoc. Off. Anal. Chem. 57/4, (1974) 910-913 Ref: Electroanal. Abstr. 13, (1975) 388

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Fig. 1 *Example program page 2 646 VA Processor*

```
 1  Determination of niacinamide in unknowns          METHOD  4  PAGE 2
 2  MPL 1          EL.TYPE MME                        GEN.SPECIFICATIONS

    PARAMETERS
 3  iR.MODE              N
 4  SPEED                5
 5  D.SIZE               5
 6  N.DROPS              5

    RECOGNITION
 7  SPIKE THRESH         5
 8  H.THRESH             4
 9  U.TOL                7
10  W.TOL                8
11  ASYM.TOL             9
```

Fig. 2 *Example program page 3 646 VA Processor*

```
    Determination of niacinamide in unknowns          METHOD  4  PAGE 3
    MPL 1          EL.TYPE MME                        OPERATION SEQENCE

    OPERATIONS/PARAMETERS                 OPERATIONS/PARAMETERS
 1  PURGE ;STIR  ;         5  s
 2  [ADDL ;OPURGE;OSTIR ;  5  s
 3  (REP  ;
 4  OME   ;MEAS  ;         5  s
 4a    M.MODE       DPN    -40  mV
 4b    T.STEP              600  ms
 4c    U.SET              -1.400 V
 5  SWP 0 ;                50  s
 5a    U.END              -1.900 V
 5b    U.STEP              6  mV
       SW.RATE             10.0 mV/ s
 6  OMEAS ;
 7  REP) 1;
 8  OMEAS ;PURGE ;STIR  ;
 9  BEEP  ;ADD1]2;         30  s
10  OMEAS ;OPURGE;OSTIR ;
11  BEEP  ;END   ;
```

Fig. 3 *Example program page 4 646 VA Processor*

```
    Determination of niacinamide in unknowns          METHOD  4  PAGE 4
    MPL 1          EL.TYPE MME                        ALLOCATIONS
    a              b            c          d          e           f
    SOLUTE         U.VERIF      DOS        V.SOLN     m.CONC      m.BLANK
    Subst          Ux           Soln       c, v       rho.x       bx
 1  Niamde        -1.700 V      1        c 100  uL     1.000 g/ L  0.000 g
 2
 3
 4
 5
 6
 7
 8

 9  SUPP.ELEC     1%TMAH+DDI pH 13.0
10  V.MEAS        20.000 mL
11  ALIQUOT       1.000
12  DATE          91-04-02
13  TIME          10:10
```

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Fig. 4 *Example program page 5 646 VA Processor*

```
   Determination of niacinamide in unknowns            METHOD  4  PAGE 5
   MPL 1          EL.TYPE MME                          DATA OUTPUT
                  a           b           c           d          e
   SEGMT          Y.AXIS/L    Y.AXIS/R    X.AXIS/DIV
 1 SWP 0          0.00 A      -1.00 uA    100  mV
 2
 3
 4
 5
 6
 7
 8

 9 RECORD         SXXX        FR
10
11 SEND
12
```

Fig. 5 *Example program page 6 646 VA Processor*

```
   Determination of niacinamide in unknowns            METHOD  4  PAGE 6
   MPL 1          EL.TYPE MME                          RES.CALCULATION
                  a           b           c           d
   ANALYTE        EVAL        R.QUANT     R.UNIT      SIGNIF.DIG
 1 Niamde         N           rho(Niamd)  mg/g        4
 2
 3
 4
 5
 6
 7
 8
                  (EV.QUANT   + ADDEND)   * FACTOR    / DIVISOR
11 Niamde         A           0.00000     532.420     1.00000
12
13
14
15
16
17
18
```

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Fig. 6 *Curve examples: Determination of nicotinamide in tablets of declared content 100 mg/tablet*

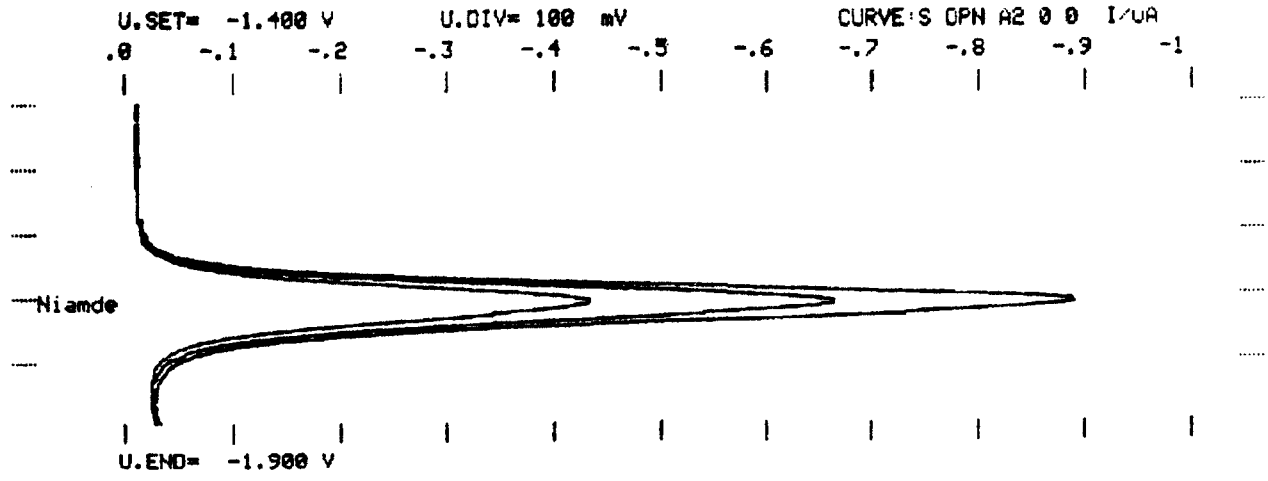

Fig. 7 *Result block of the determination from Fig. 6*

```
METROHM 646 VA-PROCESSOR  (5.646.6041)
Determination of niacinamide in unknowns              METHOD  4
MPL 1          EL.TYPE    MME

SUPP.ELEC      1%TMAH+DDI pH 13.0
V.MEAS          20.000 mL
ALIQUOT         1.000

REMARK         Detrn. of niacinamide in niacinamide tablets
               Ag/AgCl (3M KCl) reference electrode
NAME           Prof.J.G.Dick
RUN#            2

    ANALYTE     L R S       U.SUBST      EV.VALUE     DELTA        m.ANALYTE
    Niamde     A0 0 0       -1.707 V     373.6 nA
               A0 1 0       -1.708 V     376.1 nA
               A1 0 0       -1.708 V     587.0 nA
               A1 1 0       -1.709 V     587.9 nA     212.6 nA
               A2 0 0       -1.709 V     792.1 nA
               A2 1 0       -1.709 V     794.7 nA     205.9 nA
             m.STD    100.0 ug      SLOPE    477.7 ug/uA          179.6 ug

    rho(Niamd)  =     95.64         mg/g

    SMPL.V,m          1.00000 mg          IDENT Swiss Herbal vit.pp
    DATE  91-04-02  TIME    09:31
```

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Fig. 8 *Linearity curve 25 ... 225 µg nicotinamide / 20 mL*

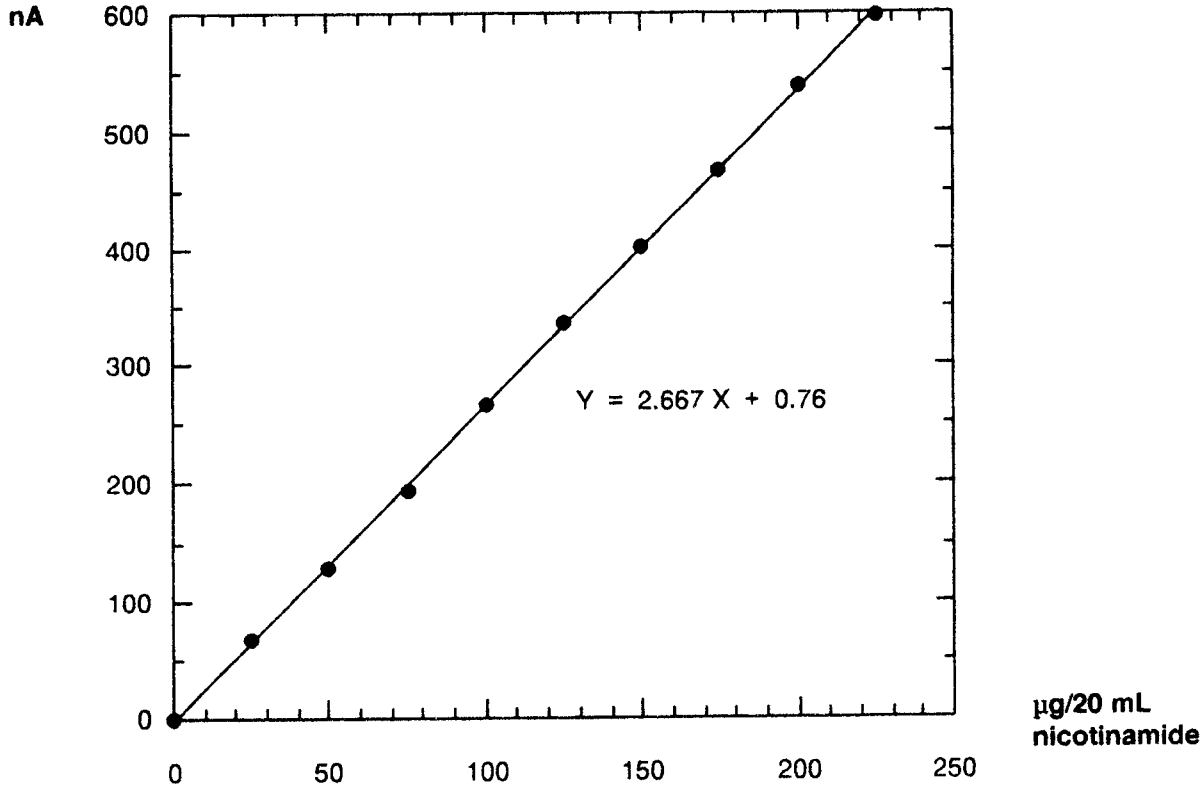

Fig. 9 *Linearity curve 100 ... 900 µg nicotinamide / 20 mL*