

USE OF COMMERCIAL GRADE SULPHURIC ACID AND SODIUM HYDROXIDE FOR THE DETERMINATION OF KJELDAHL NITROGEN IN SOIL AND PLANT MATERIALS

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A study was conducted in the year 1988 to explore the possibility of using commercial grade H_2SO_4 and NaOH in place of reagent grades of these chemicals for the determination of Kjeldahl N in soil and plant materials. Nine soils and nine plant materials having different N content were analysed using commercial grade H_2SO_4 and NaOH from different sources. The commercial grade chemicals were found to be suitable for their respective functions in the Kjeldahl method as they yielded essentially the same N values. The cost of N analysis of soil and plant materials can be reduced appreciably by using commercial grade H_2SO_4 and NaOH.

Key words: Kjeldahl nitrogen, Commercial grade chemicals.

Introduction

The kjeldahl method [1] is the most commonly used method to determine nitrogen (N) in soil and plant materials [2-9]. In most laboratories in Pakistan and other countries, H_2SO_4 and NaOH of reagent grades are used for digestion and distillation involved in the Kjeldahl method. Due to their standard purity, reagent grade chemicals are quite costly. Little data exist regarding standardization of commercial grades of these chemicals which are available in local markets at relatively low prices. These commercial grade chemicals are used for N estimation but their use require proper documentation. The present investigation was, therefore, conducted to standardize the use of these commercial grade chemicals for N determination.

Materials and Methods

Use of commercial grade H_2SO_4 and NaOH for N estimation was standardized by comparing their performance with those of reagent grade chemicals of Messrs E. Merck of West Germany, a company well known worldwide for manufacturing chemicals of standard purity. Two commercial grade H_2SO_4 products manufactured by Messrs Ittehad Chemicals (IC), Kala Shah Kaku, Lahore, and Lyallpur Chemical Fertilizers (LCF), Jaranwala Road, Faisalabad, and two commercial grade NaOH products (liquid) manufactured by Messrs IC, Kala Shah Kaku, Lahore and Sitara Chemicals (SC), Seikhupura Road, Faisalabad were collected for test. The concentration of commercial grade H_2SO_4 and NaOH reagents was determined. Quadruplicate portions of nine surface soils and nine plant materials having varied N content were analysed for Kjeldahl N [6,7,9] using reagent and commercial grade H_2SO_4 and NaOH.

Results and Discussion

Some basic data obtained regarding the chemicals tried are given in Table 1. Nitrogen contents of soil and plant materials as determined by using different H_2SO_4 and NaOH

TABLE 1. SOME BASIC DATA REGARDING DIFFERENT BRANDS AND GRADES OF H_2SO_4 AND NaOH

Chemical	Brand	Grad	Colour	Concent ration (%)	Price/kg of liquid or solid(Rs.)
H_2SO_4	Merck	Reagent	Colour- less	93.88	87.93
H_2SO_4	IC	Commer cial	Slightly brown	98.1	5.00
H_2SO_4	LCF	Commer cial	Slightly brown	98.4	3.60
NaOH (Solid)	Merck	Reagent	White pellets	100.0	125.50
NaOH (Liquid)	IC	Commer cial	Colour- less	48.1	5.40*
NaOH (Liquid)	SC	Commer cial	Colour- less	48.0	5.50

* Determined by titration method.

for digestion and distillation are presented in Table 2 and 3. The data on soils showed that irrespective of grade of acid or alkali used, the averages of all the soils were almost similar. The averages of all the plant materials were also quite identical. The data thus revealed that comparable results of N in soil and plant materials were obtained by the use of commercial grade H_2SO_4 and NaOH. Close agreement of blank titrations obtained in case of soil and plant materials where commercial grade H_2SO_4 and NaOH were used, with those obtained by using reagent grade of these chemicals (Table 2 and 3) established that commercial grade chemicals under test were as N free as reagent grade chemicals.

The prices of reagent or commercial grade H_2SO_4 and NaOH are listed in Table 1. It was found that if the cost of other chemicals involved and electricity consumed in N determination is kept constant, reagent grade H_2SO_4 and NaOH of Merck brand used per 100 samples of plant or soil

TABLE 2. TOTAL N IN SOILS AS DETERMINED BY USING DIFFERENT BRANDS AND GRADES OF H₂SO₄ AND NaOH FOR DIGESTION AND DISTILLATION.

Soil No.	Location	Total N (%) in different soils as determined by using						
		Merck H ₂ SO ₄ Merck NaOH	IC H ₂ SO ₄ Merck NaOH	LCF H ₂ SO ₄ Merck NaOH	Merck H ₂ SO ₄ SC NaOH	Merck H ₂ SO ₄ SC NaOH	IC H ₂ SO ₄ IC NaOH	LCF H ₂ SO ₄ SC NaOH
1.	Chack 217/EB, Sahiwal	0.063	0.062	0.063	0.065	0.065	0.062	0.063
2.	Moza Dhoriwala, Jhang	0.099	0.099	0.099	0.100	0.100	0.099	0.099
3.	Chak 18/Shumali, Sargodha	0.051	0.050	0.050	0.051	0.051	0.049	0.051
4.	Basti Dhol Rajian Da, Phalia, Gujrat	0.107	0.105	0.108	0.108	0.108	0.106	0.107
5.	Purana Suhawa, Jehlum	0.032	0.034	0.034	0.035	0.035	0.035	0.035
6.	Barani College, Rawalpindi	0.086	0.087	0.087	0.088	0.087	0.088	0.087
7.	Kotli Haji Pur, Sialkot	0.131	0.132	0.130	0.131	0.131	0.133	0.133
8.	Sanitorium, Murree	0.167	0.166	0.165	0.163	0.166	0.168	0.166
9.	AARI Fruit Plant Nursery, Faisalabad	0.191	0.194	0.196	0.192	0.194	0.195	0.192
	Average	0.103	0.103	0.104	0.103	0.104	0.104	0.104
	Blank titration (mL of 0.01 N H ₂ SO ₄)	0.4	0.4	0.4	0.5	0.4	0.5	0.5

TABLE 3. NITROGEN CONTENTS OF PLANT MATERIALS AS DETERMINED BY USING DIFFERENT BRANDS AND GRADES OF H₂SO₄ AND NaOH FOR DIGESTION AND DISTILLATION

S.No.	Plant material	N contents (%) of plant materials as determined by using:						
		Merck H ₂ SO ₄ Merck NaOH	IC H ₂ SO ₄ Merck NaOH	LCF H ₂ SO ₄ Merck NaOH	Merck H ₂ SO ₄ IC NaOH	Merck H ₂ SO ₄ SC NaOH	IC H ₂ SO ₄ IC NaOH	LCF H ₂ SO ₄ SC NaOH
1.	Wheat straw	0.336	0.333	0.333	0.336	0.336	0.329	0.336
2.	Rice straw	0.375	0.378	0.382	0.378	0.375	0.371	0.381
3.	Kallar grass shoot	0.917	0.921	0.928	0.931	0.921	0.914	0.906
4.	Berseem shoot	2.968	2.947	2.975	2.975	2.968	2.989	2.986
5.	Wheat grain	2.149	2.149	2.142	2.165	2.156	2.149	2.156
6.	Maiz grain	1.806	1.806	1.813	1.820	1.820	1.799	1.820
7.	Rice grain	1.155	1.169	1.176	1.162	1.162	1.141	1.169
8.	Mung bean grain	3.955	3.955	3.948	3.976	3.976	3.962	3.966
9.	Chickpea grain	3.934	3.948	3.920	3.948	3.976	3.962	3.962
	Average	1.955	1.956	1.957	1.966	1.965	1.957	1.965
	Blank titration (ml of 0.02 N H ₂ SO ₄)	0.20	0.20	0.20	0.20	0.20	0.16	0.19

N analysis cost Rs. 138.90 and Rs. 185.20, respectively; if commercial grades of these chemicals are used, the costs were Rs. 10.55 and 14.07, respectively. Thus by using commercial grade H₂SO₄ and NaOH their cost per determination of N in soil or plant material can be reduced by 92%.

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