THE QUANTITATIVE DETERMINATION OF CINNAMON IN THE FORM OF POWDER

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Saber[1] has found: (1) For barks in which the fibres occur either isolated or arranged in single files, the area of fibres per g. of the powdered bark is an excellent criterion for determining the amount of these drugs in the form of powder. (2) This datum for cinnamon is 92·5 and for cassia 13·1 sq. cm. per g., figures which differ so widely that they can be used successfully in determining the amount of cassia in cinnamon or *vice versa*. (3) The area of fibres per g. of cinnamon is in direct relation to its quality and grade, for the best quality it is about 100 and for the lowest quality, viz. featherings and chips, it is 70 and 40 respectively. (4) Samples of cinnamon that give lower results than those of quills may be either adulterated or of inferior quality.

The method for the determination of the area of fibres in powdered cinnamon bark is given by Wallis in his excellent *Practical Pharmacognosy*.[2] Briefly, the method consists of preparing 10 ml. of a suspension of 0·1 g. of cinnamon powder No. 90 and 0·05 g. of lycopodium, cleared with 3 ml. of chloral hydrate, in a suspending fluid, consisting of mucilage of tragacanth, glycerin and water (1:2:2). A mount is prepared. With the aid of a camera lucida the outlines are traced for all the fibres and portions of fibres seen in 5 strips across the cover-glass each having a width equal to the diameter of field of view (about 0·5 mm.). The outlines are cut out and the paper included is weighed. Knowing the weight of a definite area of paper (about 1 sq. dm.) and the magnification, the actual area of the fibres seen in 5 strips is calculated. Then the weight of cinnamon in the 5 strips is calculated from the number of spores in 24 fields of view and the weight of 94,000 spores = 1 mg. From the area and the weight of fibres in 5 strips and from the moisture of the cinnamon the area of fibres per g. of dry cinnamon is calculated. The results of 4 mounts, which differ by no more than about 10 per cent. of the average, are averaged.

The method, summarised above, is long and tedious. Dr. T. E. Wallis suggested to me the possibility of measuring instead of drawing the fibres. Difficulty in calculating the area of fibres from measurements of length and breadth is found in the determination of the breadth of the fusiform fibres. At first I tried to measure the area of outlined fibres cut out of paper and the results were encouraging. Then, with the aid of an ocular micrometer, I tried to measure the length and breadth of fibres seen in the microscope, while the same were drawn with a camera lucida. The results obtained being satisfactory, I have repeated the determination with the measuring method alone.

Two samples of cinnamon (*C. zeylanicum*) have been examined: (1) A powder, No. 85, kindly given by Dr. Wallis (assays 1 to 10 of Table I). (2) A powder, No. 100, made by myself from a specimen of cinnamon supplied by Merck and prepared from 20 g. of the bark, taken out of different sticks and pulverised in a mortar with a minimum of waste (assay 11). In Table I are the results of this investigation.

TABLE I

Cinnamomum zeylanicum

Suspension and sample	Area of fibres in sq. cm. per g. of powder, dried at 100° C. Ranges and average for 4 preparations of each suspension	
	Drawing and weighing	Measuring and calculating
Wallis 1	93 to 96·7 to 108	—
„ 2	88 to 95·0 to 101	—
„ 3	79 to 88·0 to 95	79 to 86·2 to 95
„ 4	85 to 91·7 to 100	78 to 87·2 to 97
„ 5	—	92 to 96 to 101
„ 6	—	85 to 92 to 97
„ 7	—	81 to 86 to 89
„ 8	—	82 to 89·5 to 101
„ 9	—	84 to 91·0 to 94
„ 10	—	86 to 93·0 to 101
Merck 11		83 to 89·5 to 102

	Drawing	Measuring
Arithmetic grand average	92·85	90·0
Average deviation	3·00	2·62
Standard deviation	3·33	3·14
Idem in parts per cent.	3·53	3·49

It appears from Table I that the determination of the area of fibres in cinnamon can be made by the measuring method quite as accurately as with the drawing method. However, this method has little advantage because it does not economise time; in reality, the calculation of the product from length and breadth and the addition of all the products is a long operation, about as time-consuming as the cutting out and weighing of the outlines; further the estimation of the average breadth of the fibres is quite as tedious as the drawing of their outlines; finally, measuring with the aid of the ocular micrometer is not easy, because for certain of the fibres seen in the field of view it is impossible to bring the micrometer to coincide with them.

The idea that the total length per g. of the fibres might be as good a criterion as the area, led me to examine this possibility. Suspensions and preparations were made with the same powder of Merck's cinnamon, described above, and also with Merck's cassia prepared in the same way as the cinnamon powder. The microscopical images were projected on to a white glass plate at a magnification of about 385 and the projected fibres were measured for length with a plastic transparent metre, divided in mm. The projection method is very easy and not so tedious as the use of a camera lucida. I have noted the results of two sets of 5 strips (series 1 alternating with series 2, viz. 1, 3, 5, 7, 9 and 2, 4, 6, 8, 10, the interval between two strips being 1·5 mm.) and the results of the sum of 10 strips, with the object of gaining an idea of the accuracy of the results from 5 strips. Table II shows the results of this investigation.

TABLE II

Cinnamomum zeylanicum (MERCK'S SAMPLE)

Suspension	Length of fibres in mm. per g. of powder dried at 100° C. Ranges and average for 4 preparations of each suspension		
	First series of 5 strips	Second series of 5 strips	Total of 10 strips
1	253 to **292** to 372	239 to **275** to 317	252 to **284** to 322
2	240 to **286** to 336	253 to **283** to 341	271 to **285** to 305
3	297 to **329** to 351	218 to **245** to 273	285 to **287** to 294
4	232 to **281** to 303	235 to **305** to 384	270 to **293** to 307
Arithmetic average ..	297	277	287
Average deviation ..	16	17	2·75
Standard deviation ..	18·9	21·5	3·50
Idem in parts per cent. ..	6·4	7·8	1·22

Cinnamomum cassia (MERCK'S SAMPLE)

1	9 to **41** to 55	40 to **47** to 61	35 to **44** to 48
2	6 to **34** to 58	24 to **53** to 77	31 to **44** to 57
3	46 to **50** to 55	26 to **39** to 55	38 to **45** to 52
4	37 to **49** to 62	24 to **36** to 62	31 to **43** to 62
Arithmetic average ..	43·5	43·75	44
Average deviation ..	6	6·25	0·5
Standard deviation ..	6·5	6·68	0·707
Idem in parts per cent. ..	14·9	15·0	1·6

The results in Table II show that the length of fibres per g. is quite as good a criterion as is the area of fibres per g. The datum for cinnamon (287) and that for cassia (44) differ so widely that they can be used successfully in determining the amount of cassia in cinnamon or *vice versa*. The ratios are as follows:

$$\frac{C.\ zeylanicum}{C.\ cassia} \quad \text{Area} \quad \frac{92{\cdot}5}{13{\cdot}1} = 7 \quad \text{Length} \quad \frac{287}{44} = 6{\cdot}5$$

From Table II it can be seen that the results of 5 strips are more accurate for *C. zeylanicum* than for *C. cassia*. It is, however, advisable to count the results from 10 strips for both. The measurement of the length of fibres is much quicker and easier than the determination of the area by drawing or by measuring.

For these experiments it was important to have preparations which last longer than those with tragacanth–glycerin–water mixture. A clarified suspension in oil is excellent and can be prepared as follows. Weigh out 0·1 g. of powdered cinnamon and mix it on a plate (glass or porcelain) with 0·5 ml. of solution of chloral hydrate (5 in 2), clear by keeping overnight (18 hours) in a humid chamber at ordinary temperature, and dry the mixture at ordinary temperature. Add to the dry clarified powder 1 ml. of a solution of camphor in ether and liquid paraffin (3:3:1), mix and add to about 10 ml. of a suspending fluid, consisting of a 1 per cent. solution of aluminium monostearate in liquid paraffin. Weigh 0·05 g. of lycopodium and add this to the suspension of cinnamon. The homogeneity of the suspension can be improved by the use of a magnetic stirrer. The suspension prepared by this method shows well clarified cinnamon particles and shows hardly any tendency to settle when allowed to stand for several weeks. With such a suspension in

oil the preparations on microscope slides may be kept in a slide-box without danger of deterioration or desiccation.

Summary and Conclusions

1. The area of fibres per g. in cinnamon can be determined by calculation from measurements of length and breadth with the same accuracy as by drawing.

2. The length of fibres per g. from cinnamon and from cassia is also an excellent criterion for their quantitative determination.

3. The ratio of the length of fibres per g. of *C. zeylanicum* to that per g. of *C. cassia* is nearly the same as the ratio of the area of fibres from these two spices.

4. A quasi stable suspension of clarified cinnamon in liquid paraffin can be obtained by adding to it 1 per cent. of aluminium monostearate. A method is described for clarifying the cinnamon with solution of chloral hydrate previous to adding the oil. A magnetic stirrer improves the homogenity of the suspension in oil.

To Dr. T. E. Wallis I wish to renew here my grateful acknowledgment for suggesting the subject of this research, for kind encouragement, for following my work step by step and for the sample of cinnamon. I should like to express my sincere thanks to Prof. A. Hifny Saber for sending a copy of his method of determination, and to my assistants, Mrs. Ragula and Mrs. Schelesowska, and my students, Roosemont and Swinnen, for preparative work.

References

1. Saber, *Quart. J. Pharm. Pharmacol.*, 1940, **13**, 7.
2. Wallis, *Practical Pharmacognosy*, 5th edition, 1948, p. 177.