ing and acquaint them with the types of standard commercial equipment available to carry on the different elements of processing in the many special areas of the food industries.

This is not an engineering textbook in the usual sense but a descriptive introduction to food processing. Since it attempts to cover everything from washing spinach and dehairing hogs to freezing and canning in a total of 347 pages, there can be no exhaustive treatment of any of these operations. However, because so many engineering students have little or no acquaintance with food processing, this book should provide them with a needed general view of the types of operations and, in particular, the kind of equipment normally used in the food industries. The information is sufficient to indicate the principles involved in the handling of food products as differenitated from other materials.

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Heat Transmission. William H. McAdams. McGraw-Hill, New York–London, ed. 3, 1954. xiv + 532 pp. Illus. $8.50.

The third edition of this outstanding textbook and reference book reflects the progress made in the area of heat transmission since the publication of its predecessor 12 years ago. New information and data have been added to provide an up-to-date presentation of practically all phases of heat transfer that are of interest to practicing engineers, scientists, and students. The book provides a critical review of much of the existing experimental data, thereby relieving the design engineer of comparing and evaluating data from several sources.

The general modes of heat transfers, conduction, radiation, and convection are covered in 15 chapters. The chapter titles are "Introduction to heat transmission," "Steady conduction," "Transient conduction," "Radiant-heat transmission," "Dimensional analysis," "Flow of fluids," "Natural convection," "Introduction to forced convection," "Heating and cooling inside tubes," "Heating and cooling outside tubes," "Compact exchangers," "High-velocity flow," "Condensing vapors," "Boiling liquids," and "Applications to design." Many useful tables and charts are included in the appendix. An extensive and important bibliography and author index are presented for each chapter.

One of the significant modifications in the third edition is a revision of the chapter, "Radiant-heat transmission," which was prepared by H. C. Hottel. New charts have been included for evaluating the emissivity in the section on gas radiation. The carbon dioxide and water vapor charts have been expanded to allow the engineer to estimate the gas radiation at temperatures encountered in rocket work. A new generalized procedure based on the use of determinants has been incorporated to cover the case of radiant energy exchange in a multisurface gray enclosure containing a nongray absorbing and emitting gas.

Another new feature of the third edition is the addition of chapters entitled "Natural convection," "Compact exchangers—packed and fluidized systems," and "High-velocity flow; rarefied gases." Much of the material in the latter two chapters was heretofore available only in scattered technical publications.

This is an authoritative treatment of the field of heat transfer and is highly recommended for engineers and scientists who are engaged in analyzing problems in this area of engineering.

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Technical Papers

Nuclear Volume and Testosterone-Induced Changes in Secretory Activity in the Submaxillary Gland of Mice

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The secretory activity of the tubular portion of the submaxillary gland in mice is stimulated by androgens (*1*), and it has been demonstrated that this is correlated with a significant increase in the volume of the nucleus (*2*). These findings favor the view that the nuclear volume is related to the secretory activity of the cell (*3*).

Junqueira (*4*), Rabinovitch (*5*), and Fernandes and Junqueira (*6*) have shown that ligature of the excretory duct induces a considerable diminution of the secretory activity of the cells. The glands, however, do not degenerate and are able to respond in the normal way to stimulation by testosterone. Such findings offer new approaches to the study of nuclear phenomena as related to cell secretion, since they permit control of the secretory activity of the cells.

Male white mice were used in the present study. The ducts of the right submaxillary glands were ligated, the left glands serving as controls. In a first set of experiments, 20 mg of testosterone propionate in powder form was implanted under the skin of adult mice 30 days after the ligature of the excretory ducts. Control animals were submitted to the same operation, the implantation of the drug being omitted. The animals were killed 15 days later, and the submaxillary glands were removed and fixed 6 hr in Helly's fluid. In a second set of experiments, immature animals weighing 15 g were castrated, the right submaxillary glands

Table 1. Nuclear volumes (μ^3) of the tubular portion of the submaxillary gland of mice. The numbers in each section refer to nuclear volume and standard error of the mean. The numbers of the nuclei measured are given in parentheses.

Untreated animals		Testosterone propionate-treated animals	
Control gland	Duct-ligated gland	Control gland	Duct-ligated gland
Adult male mice (Set I)			
101,1 ± 2,2 (110)	91,5 ± 2,4 (112)	103,0 ± 2,0 (104)	106,2 ± 2,1 (119)
86,2 ± 2,5 (127)	73,7 ± 3,2 (126)	109,2 ± 2,4 (125)	105,8 ± 2,2 (116)
92,9 ± 1,9 (128)	92,0 ± 2,0 (138)	132,4 ± 3,2 (116)	97,2 ± 2,1 (147)
82,6 ± 2,7 (118)	68,1 ± 3,8 (110)	119,0 ± 2,6 (108)	128,4 ± 3,0 (92)
82,0 ± 2,8 (105)	72,7 ± 3,0 (107)	101,6 ± 2,0 (110)	101,5 ± 2,2 (110)
88,3 ± 2,2 (113)	69,8 ± 3,3 (133)		
89,8*	78,2*	113,2*	106.4*
Castrated immature male mice (Set II)			
108,7 ± 2,1 (98)	93,5 ± 2,2 (100)	114,8 ± 3,4 (96)	136,1 ± 4,5 (97)
99,2 ± 2,2 (99)	78,2 ± 3,0 (99)	130,8 ± 2,8 (100)	125,0 ± 3,4 (101)
125,5 ± 3,3 (100)	105,6 ± 2,1 (100)	140,2 ± 4,6 (100)	134,7 ± 4,0 (100)
115,4 ± 2,5 (99)	102,1 ± 2,0 (105)	142,9 ± 5,2 (99)	152,9 ± 4,3 (99)
		129,0 ± 3,8 (100)	126,4 ± 3,2 (101)
112,3*	95,0*	131,7*	134,9*

* Weighted mean.

ligated, and on the following day 20 mg of testosterone propionate was implanted. In the control animals the hormone was omitted. The animals were killed 30 days later.

The nuclear volumes were measured on 15-μ thick sections stained by Feulgen's method. The nuclei were selected at random, their outlines were drawn at a magnification of 3350, and two perpendicular diameters were measured, according to the method of Olivo, Porta, and Barberis (*7*).

The volume V of the nucleus was calculated by means of the formula

$$V = \frac{\pi}{6} \times \left[\frac{D_1 + D_2}{2}\right]^3,$$

where D_1 and D_2 are the respective nuclear diameters.

The statistical analysis of the results was made after grouping the values in frequency classes with a class interval of 10 μ^3.

The tissues of animals used in each set of experiments were treated exactly in the same way. However, the two sets of experiments are not comparable, owing to difference in handling the specimens during the paraffin inclusion. Hence, the results of the two sets of experiments must be considered separately.

Table 1 shows, for individual animals, the mean nuclear volume in cubic microns, the standard error of the mean, and the number of nuclei measured.

Preliminary analysis of variance made in the conventional way revealed in both cases the existence of an interaction between testosterone and ligature. For this reason, the definitive analysis was made using the method of the unweighted means of Yates (*8*) for the case of a fourfold table. The following results were obtained.

1) Following testosterone propionate administration, a highly significant increase in the nuclear volumes is observed in both sets of experiments ($F = 859$ and $F = 553$). The F-values are the variance ratios, calculated according to the F-test of Snedecor (*9*).

2) The values of F for the "ligature" factor are also high and superior to the 1-percent level. This result indicates a statistically significant difference between the nuclear volumes of the ligated duct gland and these volumes in the control gland.

3) The F-value for the "interaction" factor is found to be significant in both sets of experiments. In the first case the F-value ($F = 4{,}6$) lies between the 1-percent and 5-percent level, and in the second one ($F = 66{,}3$) it is higher than the 1-percent probability level ($F_{1\ \mathrm{percent}} = 6.6$, $F_{5\ \mathrm{percent}} = 3.8$). This result leads to the conclusion that the responses of the intact and the ligated duct glands to the testosterone are significantly different. It is obvious that the ligated duct glands show more intense reactions.

The foregoing results indicated the desirability of a more accurate evaluation of the phenomena. For this reason separate variance analyses were made in both sets according to the methods indicated by Snedecor (*9*).

The results reveal the following: Without testosterone administration, the nuclear volume is significantly less in the ligated-duct glands than in the intact glands ($F = 19.98$ in the first set of experiments; $F = 88{,}5$ in the second set). Following testosterone administration, no significant difference could be observed between the glands ($F = 0.45$ in the first set of experiments, $F = 0.43$ in the second set).

Thus, the nuclei of the ligated-duct glands, although they are initially significantly smaller than the nuclei of the intact glands, are able to respond to testosterone administration in such a way that the final volume is identical in both cases. This indicates that the diminution of the nuclear volume after ligature of the excretory duct is not the result of cellular degeneration, since the nuclei respond to the same extent to pharmacological stimulation. It may be admitted that this diminution is related to the lowering of secretory activity.

In conclusion, the present study (*10*) reveals that an increase in the size of the nuclei of the submaxillary gland occurs after stimulation of glandular activity induced by testosterone propionate administration. This has been observed in controls and in glands in which the excretory duct was ligated. Ligature of the excretory duct significantly reduces the nuclear volume. This diminution is not related to cellular degeneration and is attributed to the lowering of secretory activity by the interruption of the salivary flow.

References and Notes

1. A. Lacassagne, *Compt. rend. soc. biol.* **133**, 227 (1940).
2. V. Valeri, *Compt. rend. acad. sci. (Paris)* **238**, 1613 (1954).
3. A. Benninghof, *Anatomische Nachrichten* **1**, 50 (1950), cited by J. Clavert, *Arch. Anat. microsc.* **41**, 209 (1952).
4. L. C. U. Junqueira, *Exptl. Cell Research* **2**, 328 (1951).
5. M. Rabinovitch, doctoral thesis, Universidade de São Paulo (1951).
6. J. F. Fernandes and L. C. U. Junqueira, *Exptl. Cell Research* **5**, 329 (1953).
7. O. Olivo, E. Porta, and L. Barberis, *Arch. ital. anat.* **30**, 34 (1932).
8. F. Yates, *J. Agr. Sci.* **23**, 108 (1933).
9. G. W. Snedecor, *Statistical methods* (Iowa State College Press, Ames, ed. 4, 1946).
10. I wish to thank Harold Deutsch for the English translation and Lucien Lison for the assistance throughout the course of this investigation.

6 July 1954.

Exudate of the Mushroom, *Polyporus dryadeus*

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Clear reddish-brown droplets of fluid appear on the surface of a large, flat basidiomycete, *Polyporus dryadeus* (*1*), although this exudate is not present under all conditions in the plant's life. The exudate attracted my interest (i) because of the copious rate of production of the clear fluid (tens of milliliters were readily collected by pipetting, and this was replaced by freshly formed exudate in a matter of hours), and (ii) because shallow but definite pits were present on the surface of the plant, where the pools of exudate had been sitting, which indicated that the fluid might have a fungilytic or fungicidal action.

The exudate is slightly acid, with a *p*H around 5. The material responsible for the reddish-brown color is almost completely precipitated by adding 5 vol of 95 percent ethanol to the original exudate; hardly any precipitation by alcohol takes place if the exudate is made slightly alkaline or more acid. The alcohol precipitate is not dissolved by petroleum ether or by carbon tetrachloride, but it does dissolve in ethyl ether. There is no precipitation upon addition of trichloracetic acid to the exudate. Boiling the original fluid, with or without the addition of strong NaOH, does not alter the color. Addition of 0.1 percent $FeCl_3$ solution to the almost colorless supernatant fluid (obtained after alcohol precipitation of the coloring matter) gives a strong yellow color test, suggesting the presence of organic acids (*2*). The color of the exudate changes with alterations of its *p*H, becoming a light yellow below about *p*H 4.5 and becoming a dark brown at about *p*H 7 and higher.

Pigmented substances have been found and identified in some related organisms. For example, "polyporic acid" (3,6-dihydroxy-2,5-diphenyl-4,4-benzoquinone) has been extracted from *P. nidulans* and *P. rutilans* (*3*). But, unlike "polyporic acid," the coloring matter in the exudate of *P. dryadeus* does not give a violet color with dilute ammonia, nor is it precipitated to any extent by HCl. It also appears to have distinctly different solubility properties from the colored substances in another preparation, "polyporin," which has been described by Bose (*4*) as a filtrate of a culture of *Polystictus sanguineus*. It seems improbable that the pigment in the exudate of *P. dryadeus* belongs to the group of "humins" that may result from autolytic tissue breakdown of proteins containing cyclic amino acids (*5*). The presence of the colored droplets on the surface of *P. dryadeus* seemed to precede rather than to follow the appearance of the pits underneath them. In contrast to the pigment under study, the humins are reported to become darker and to be precipitated in HCl and also to be precipitated by alcohol from an alkaline medium.

The collected exudate did not lose its clarity or undergo any obvious changes in color for months, even though it was collected and stored (at about 5°C) under nonsterile conditions and without the addition of any antibacterial agent. Although there have been reports of a lack of antibiotic activity by *P. dryadeus* against some bacteria (*Staphylococcus aureus* and *Escherichia coli*) (*6*), there was no mention of whether the exudate discussed in this paper was used in the test or was being produced by the plant at the time; and evidently no test of antifungal activity was attempted. Antifungal activity has been reported for another polypore, *P. biformis* (*7*).

Further purification of the pigment in the exudate of *P. dryadeus* and more adequate testing of it for antibiotic activity, especially for antifungal activity, would appear to be very desirable. Of additional interest is the question of the biological significance of the pitting or apparent degeneration of the mushroom's surface in response to its own exudate.

References and Notes

1. I am indebted to L. Bonar and Ralph Emerson of the University of California, Berkeley, for identifying the organism. I also wish to thank E. Jorgensen of the College of Pharmacy, University of California, San Francisco, for consultation on some points in this paper.