

## OBSERVATIONS ON THREE LOUISIANA CAPSICUMS.

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During the past year the writer received specimens of the entire flowering and fruiting plants and dried fruits of a number of pungent red peppers grown at New Iberia and at Avery Island, La., for the purpose of making a botanical and pharmacognostic investigation to determine their identity, structure and their suitability as additional available sources of U. S. P. Capsicum.

Three of the more promising of these pungent peppers, namely, "Louisiana Long," "Louisiana Sport" and "Tabasco," which are used as spices, were first selected for study.

The purpose of this paper is to report his observations made upon these which include the study of the entire plants, fruits, seeds, sections of fruits and seeds, ground whole fruits, pungency tests, moisture, non-volatile extractive and ash.

## CAPSICUM, LOUISIANA LONG.

This variety has been grown in Louisiana since about 1845 where it is known as "Long Cayenne" and "La. Longs." Its ground fruits have been used as a flavor especially for sausage and bologna.



Fig. 1.—*Capsicum annuum* L. var. *longum* Sendt., the source of Louisiana Long Capsicum.  $\frac{1}{8} \times$ .



Fig. 2.—Hybrid between Old Louisiana Sport Capsicum of Oriental origin and Honka variety of Japanese Capsicum, the source of the new Louisiana Sport Capsicum.  $\frac{1}{8} \times$ .

The plants studied were erect, frutescent, with greenish, often purple-striate branches and up to 3 ft. in height. The leaves were entire, ovate, petiolate, with acuminate apex, dark green, from 1 to 4 in. long and from  $\frac{3}{4}$  to 2.5 in. wide, with petioles sometimes exceeding the lamina. The flowers were large, white, with a 5-pointed, gamosepalous, pateriform calyx and spreading corolla. They were

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borne solitary on curved or straight peduncles, the latter up to  $1\frac{1}{4}$  in. in length and enlarging toward the calyx end. The fruits were red, oblong-conical, straight to frequently curved, up to 15 cm. in length and up to 2.5 cm. in breadth with pungent pericarp and seeds. (See Figs. 1 and 4A.)

The plants of this variety examined corresponded to the description by Irish (1) of *Capsicum annuum* L. var. *longum* Sendt. (2), and some of the specimens of fruits resembled Irish's figure of the Cardinal form of this variety in Pl. 13, Fig. 1 of his "Revision of the genus *Capsicum*." L. H. Bailey (3) in *Gentes Herbarum* regards this and other horticultural forms of *Capsicum* as forms of one species and calls this variety "*Capsicum frutescens* L. var. *longum* Sendt."

*Description of Fruit*.—Dried fruit oblong-conical, often curved, irregularly wrinkled, up to 15 cm. in length and up to 2.5 cm. in width, red to reddish brown,

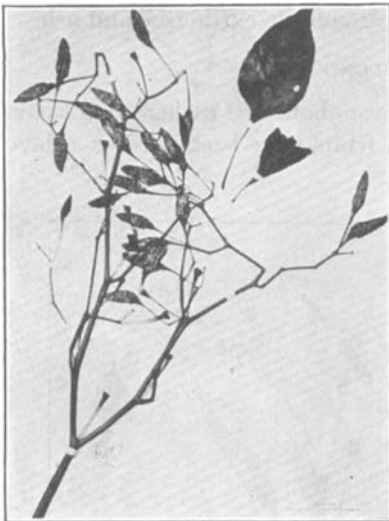


Fig. 3.—*Capsicum annuum* Linné. var. *conoides* Irish, the source of Tabasco pepper.  $\frac{1}{8}$  X.

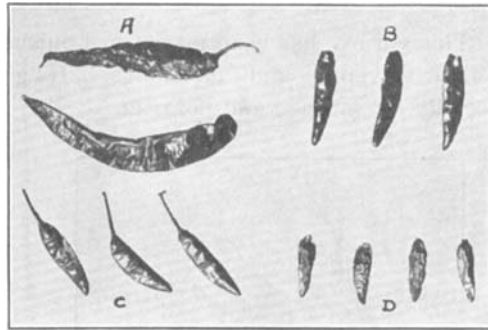


Fig. 4.—Four kinds of Louisiana grown pungent red peppers. A, La. Long; B, La. Sport; C, African Chillies  $\times$  Japanese Capsicum (hybrid); D, Tabasco.  $\frac{1}{8}$  X.

2 to 3 celled; width of pericarp about 1 mm.; the calyx, when present, loosely enveloping the base, turbinate, gamosepalous, with a 5-toothed margin. Seeds flattened, sub-orbicular, albuminous, with a thick marginal ridge, up to 4 mm. in diameter; odor of crushed fruits aromatic; taste of pericarp very pungent and of seed, pungent.

*Histology*.—(A) Pericarp. Transverse sections of the pericarp showed (1) an epicarp with cuticularized outer and radial walls, the latter frequently beaded or constricted, the cuticle of the outer walls being up to  $19\mu$  in thickness, the depth of the epicarp cells up to  $38\mu$ . (2) A mesocarp consisting of an outer region or hypodermis of somewhat collenchymatous cells, an inner broad region of thin-walled parenchyma containing red, orange and yellow chromoplasts and oil droplets and pervaded by bundles, and an inner layer of large giant cells. (3) An endocarp composed of a layer of stone cells and thin-walled, inner epidermal cells. Chromoplasts and oil droplets occurred in the outer epidermis, hypodermis, mesocarp parenchyma and endocarp. (See Figs. 5, 6 and 7L.)

Surface sections of the epicarp showed polygonal, quadrangular, to more rarely triangular epidermal cells with beaded, vertical walls, the latter up to about  $11.4\mu$  in thickness. The polygonal cells were sometimes elongated and from  $38\mu$  to  $125\mu$  in length and from  $19\mu$  to  $45.6\mu$  in width. Most of the epicarp cells had a large nucleus, a prominent nucleolus and orange to red chromoplastids and oil droplets.

(B) Seed. Transverse sections of the seed showed (1) a seed coat whose outer epidermis was composed of stone cells with extremely thick radial walls, the radial depth of some of the largest of these cells being up to  $171\mu$ , the outer walls of these being up to  $38\mu$  in thickness, (2) a broad endosperm of reserve parenchyma and (3) parts of a curved embryo. The endosperm cells appeared somewhat thinner walled than in the "Louisiana Sports" and "Tabasco" varieties.

Surface sections of the outer epidermis of the seed coat showed sinuate stone cells with greatly lignified and contorted walls, up to  $332\mu$  in length and with large pore canals.

*Powdered Louisiana Long.*—Red. Numerous fragments of large-celled parenchyma of mesocarp with thin cellulose walls and containing red to orange chromo-

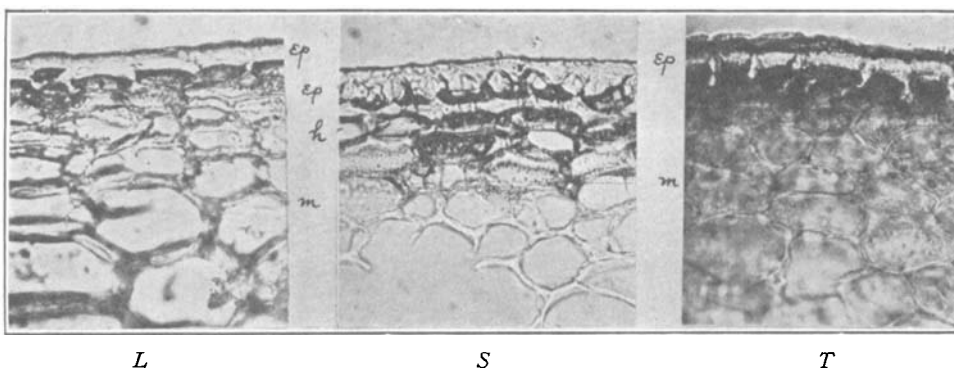


Fig. 5.—Transverse sections through the outer region of the pericarps of three Louisiana Capsicums.  $\times 300$ . *L*, Capsicum, La. Long; *S*, Capsicum, La. Sport; *T*, Tabasco. *ep*, epidermis; *h*, hypodermis; *m*, mesocarp.

plastids and oil droplets and elaioplastids, fragments containing groups of yellow stone cells of the endocarp, the latter with sinuate, porous and beaded vertical walls up to  $15\mu$  in thickness; fragments of the epidermis of the seed coat with large, sinuate, porous stone cells with thick, lignified walls, the latter frequently up to  $38\mu$  in thickness, occasionally up to  $64\mu$  in thickness; fragments of thin-walled cells of endocarp with cellulose walls and containing orange to red or brown chromoplastids and oil globules, often adherent to stone cells; numerous fragments of epicarp with beaded, polygonal to irregularly quadrangular or triangular vertical walls up to  $11.4\mu$  in thickness; fragments of the endosperm showing small-celled parenchyma containing aleurone grains and fixed oil globules.

*Moisture.*—One sample of authentic ground drug was examined for moisture determination according to the U. S. P. method and found to contain 9.77%.

*Ash.*—The total ash of one authentic sample was 4.95% and the acid-insoluble ash of this sample was 0.12%. The total ash of 10 other samples claimed to be

authentic and reported by J. Harney varied from 4.20% to 5.50% while the acid-insoluble ash of these varied from 0.10% to 0.35%.

*Ether Extract.*—The ether extract, as determined by the U. S. P. method for one authenticated sample was 16.4%, the volatile extractive of this being 1.63% and the non-volatile extract, 14.85%. The non-volatile ether extract of 10 samples reported upon by J. Harney varied from 15.25% to 17.40%.

#### CAPSICUM, LOUISIANA SPORT.

The plants received from Louisiana were compact-bushy, up to 2½ ft. in height with petiolate, ovate, acuminate leaves. The fruits were oblong-conical, red, glossy, up to 5.5 cm. in length and up to 13 mm. in diameter, and borne on ends of peduncles that attained the length of 2.5 cm. (See Figs. 2 and 4*B*.)

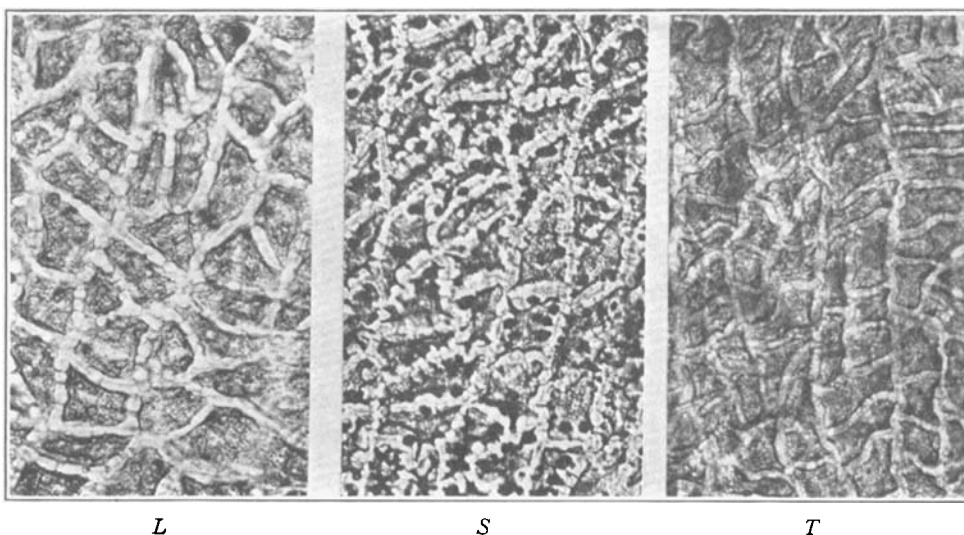


Fig. 6.—Surface sections of the epicarps of three Louisiana grown Capsicums.  $\times 200$ . L, La. Long; S, La. Sport; T, Tabasco.

According to information received from Professor Julian C. Miller of Louisiana State University, the old original Sport Capsicum was probably introduced into Louisiana around 1900 by R. E. Thompson, Sr., of Norwood, La., and is stated by R. E. Thompson, Jr., to be of Oriental origin, the seed coming from Japan. The new Louisiana Sport which has been developed by Professor J. C. Miller is darker and more prolific and represents a hybrid between the old Louisiana Sport and the Japanese variety of Capsicum known as "Honka."

*Description of Fruits.*—Dried fruits oblong-conical, red to reddish brown, glossy, up to 5.5 cm. long and up to 13 mm. in diameter, some with a saucer-shaped, gamopetalous calyx having 5 reduced, blunt teeth; odor aromatic and sternutatory, upon crushing; taste of pericarp and seeds very pungent.

*Histology.*—(A) Pericarp. Transverse sections of the pericarp showed (1) an epicarp of epidermal cells up to  $38\mu$  deep and from  $34\mu$  to  $76\mu$  in length with cuticularized outer, inner and radial walls, the outer walls with cuticle up to  $26.6\mu$  in

thickness; (2) a mesocarp consisting of an outer hypodermis of from one, two or rarely three rows of hypodermal cells with cuticularized walls, a broad middle zone of parenchyma whose cells contain red, orange and yellow chromoplastids and fixed oil droplets, which is traversed by bundles, and an inner zone of one layer of giant cells; (3) an endocarp of a single row of stone cells interspersed with thin-walled inner epidermal cells. (See Figs. 5, 6 and 7S.)

Surface sections of the epicarp showed the cells to be quadrangular, rectangular, polygonal and triangular in shape with a striated cuticle. The vertical walls of the epicarp cells were yellow and beaded. The cells were  $34\mu$  to  $76\mu$  in length and  $20\mu$  to  $64\mu$  in width.

Surface sections of the hypodermis showed the cells to be of rounded to irregu-

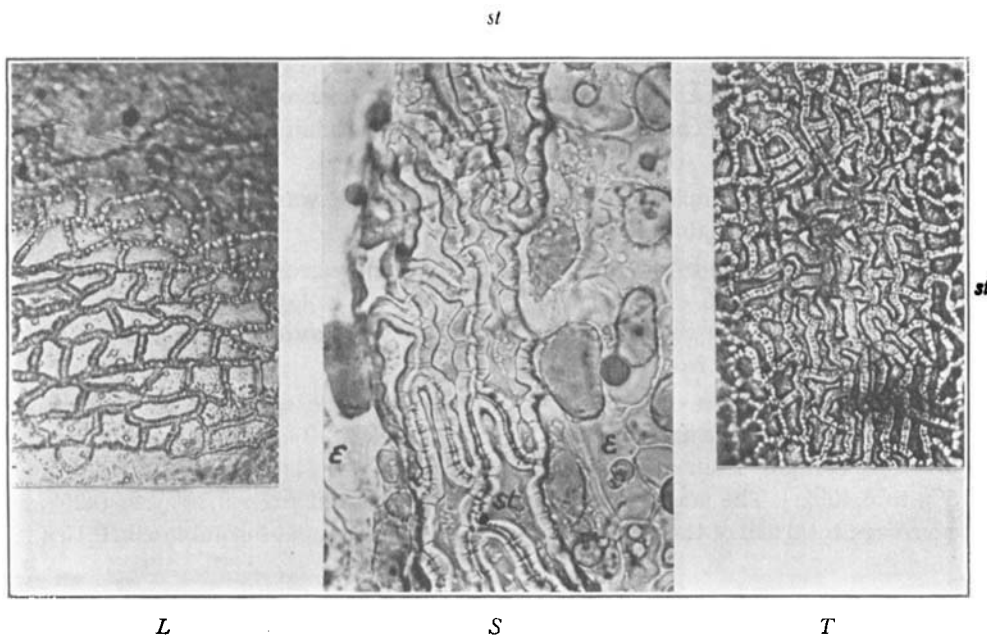


Fig. 7.—Surface sections of portions of the endocarp of three Louisiana Capsicums.  $\times 80$ . *L*, Capsicum, La. Long; *S*, Capsicum, La. Sport; *T*, Tabasco. *E*, soft, inner epidermal cells of endocarp; *st*, stone cells of endocarp.

larly rounded outline with colorless, beaded, cuticularized walls and thickened angles and containing red and orange chromoplastids and oil globules.

Surface sections of the endocarp showed irregular groups of sinuate stone cells separated by thin-walled, inner epidermal cells. The stone cells possessed sinuate, lignified and beaded vertical walls from  $3.8\mu$  to  $15.2\mu$  in thickness. The endocarp stone cells contained yellow to orange-colored chromoplastids.

(B) Seed. Transverse sections of the seed showed similar regions to those of the other Capsicums. The outer epidermis of the seed coat possessed extremely lignified stone cells, the depth of the larger stone cells being up to  $156\mu$ . In surface sections these stone cells had sinuous, contorted, vertical walls up to  $26.6\mu$  in thickness. The cells were up to  $342\mu$  in length, the walls being usually narrower than the lumen.

The endosperm and embryo contained small-celled parenchyma with aleurone and fixed oil contents. No crystals were observed in the endosperm.

*Powdered Louisiana Sport Capsicum*.—Red. Under the microscope it showed numerous fragments of epicarp composed of quadrangular, rectangular, polygonal and triangular cells with cuticularized walls, the cells being from  $34\mu$  to  $76\mu$  in length,  $20\mu$  to  $64\mu$  in width and up to  $38\mu$  in depth, occasional rows of cells in some fragments being in parallel series as in African Chillies; fragments of hypodermis with rounded to irregularly rounded cells with colorless, beaded, cuticularized walls and thickened angles and containing red or orange, irregular shaped chromoplastids and oil globules; fragments of endocarp with irregularly sinuate, beaded stone cells containing chromoplastids, the walls of which are up to  $11.4\mu$  in thickness with adherent thin-walled parenchyma containing red and yellow chromoplastids and orange oil globules; numerous yellow, irregular fragments of the epidermis of the seed coat composed of irregular, strongly lignified stone cells with very irregular lumen, the walls being frequently thicker than the lumen; numerous fragments of the endosperm and embryo consisting of parenchyma containing aleurone grains and fixed oil globules.

*Moisture*.—One sample of authentic ground drug was determined by the U. S. P. method to contain 8.78% of moisture.

*Ether Extract*.—The total ether extract of a recently ground sample of authenticated fruit was 18.395 of which 0.64% represented volatile ether extract and 17.75% represented non-volatile ether extract. The non-volatile ether extract of 12 other samples varied from 17.02% to 20.45%.

*Ash*.—The total ash of a recently ground authentic specimen of fruit was 5.38%, the acid-insoluble ash of this sample being 0.11%. The total ash determined on 12 other samples from different crops grown at New Iberia, La., varied from 3.75% to 5.40%. The acid-insoluble ash of these varied from 0.10% to 0.25%. The average total ash of these was 4.52% and the average acid-insoluble ash, 0.15%.

#### TABASCO PEPPER.

The Tabasco plants were identified as *Capsicum annuum* L. var. *conoides* Irish. This variety of Red Pepper was probably introduced into Louisiana from the state of Tabasco in Mexico and has been grown on a large scale by the McIlhenny family for several generations on Avery Island, La. The fruit has been chiefly employed in the preparation of Tabasco sauce. It was introduced in 1840.

The plants examined were suffrutescent with ovate leaves from 1 to 3 in. long and from  $\frac{3}{4}$  to 2 in. in width. The flowers were small, greenish white and borne on slender, erect peduncles up to 3.3 cm. in length. The calyx was obconical or cup-shaped, embracing the base of the fruit, the corolla greenish white, gamopetalous. The fruits were very pungent and represent sub-conical to oblong-conical berries, from 2 to 4 cm. in length and up to 9 mm. in thickness. The plants answered to the description by Irish (1). (See Figs. 3 and 4D.)

J. C. Miller (4) recently reported having developed two strains of the Tabasco pepper, one, bearing a long slender fruit intended for pickling whole, and the second, bearing a shorter fruit which dehisced from the bush very readily in the green state. The latter type is used in making sauce, since its pericarp is thicker.

*Description of Fruit.*—The dried fruits were sub-conical to conical-oblong with a tubular-campanulate (cup-shaped) calyx embracing the base of the fruit. The peduncles, present on some of the fruits were slender and varied from 28 mm. to 33 mm. in length. The fruits were from 2 to 4 cm. in length and up to 9 mm. in thickness, red to salmon red, sometimes blotched with yellow, the wall of the pericarp being up to 1 mm. in thickness. The wall of the pericarp in preserved fruits was up to 2 mm. at the base. The seeds were sub-orbicular, albuminous, thickened along margin, with a prominent beak at the micropyle and up to 3 mm. in diameter.

*Histology.*—(A) Pericarp. Under the microscope, transverse sections of the pericarp presented for examination (1) an epicarp of tangentially elongated epidermal cells with highly cuticularized outer and radial walls, the length of these cells being from  $19\mu$  to  $76\mu$  and their depth up to  $30.4\mu$ . The thickness of the outer cuticularized wall was frequently up to  $19\mu$ . (2) The mesocarp consisted of an outer region of 3 to 4 layers of tangentially elongated, collenchyma cells containing red, orange and yellow chromoplastids and oil globules, the cells becoming larger inwardly, a broad middle zone of large-celled parenchyma with chromoplastid and oil contents, some of the cells containing in addition monoclinic prisms. This zone was traversed by bundles. Bounding the inner margin of the middle zone was a layer of large giant cells separated by triangular strands of thin-walled, small-celled parenchyma. (3) The endocarp consisted of a layer of stone cells beneath each giant cell separated by thin-walled inner epidermal cells between adjacent stone cell layers. The stone cells possessed beaded, lignified, outer, radial and inner walls and were somewhat square in shape. In some sections the stone cells were continuous beneath the parenchyma separating the lower portions of the giant cells. (See Figs. 5, 6 and 7T.)

(B) Seed. Transverse sections of the seed showed: (1) an outer epidermis of the seed coat with large, yellow stone cells with greatly thickened, lignified, radial and inner walls, the cells being larger along the thickened margin of the seed where they were up to  $198\mu$  in radial length; (2) an arrow zone of collapsed parenchyma, thicker along the margin of the seed; (3) an inner epidermis of the seed coat of tangentially elongated, more or less collapsed cells; (4) a perisperm consisting of a layer of square to tangentially elongated cells with aleurone contents; (5) an endosperm of varying diameter composed of moderately thick-walled parenchyma containing tiny protein granules and oil globules. A number of monoclinic prisms were observed in the cells of this region. The outermost layer of cells of the endosperm possessed greatly thickened walls. (6) An embryo of small-celled parenchyma and epidermis.

Surface sections of the epicarp showed mostly irregularly rectangular or quadrangular, occasionally irregularly polygonal or triangular epidermal cells, from  $30.4\mu$  to  $76\mu$  in length and  $13.3\mu$  to  $19\mu$  in width frequently arranged in parallel rows.

Surface sections of the seed coat showed the outer epidermal cells to be sinuous, contorted with irregularly thickened, lignified, vertical walls, up to  $202\mu$  in length, the width of the walls up to  $26.6\mu$ .

*Powdered Tabasco.*—Reddish brown. Numerous fragments of large-celled parenchyma of the mesocarp containing red, orange and yellow chromoplastids and yellow oil globules and small elaioplastids; numerous pale yellow oil globules; fragments of endocarp with irregular, sinuate stone cells, the vertical walls of which

are up to about  $7.5\mu$  in thickness adherent to which are frequently thin-walled inner epidermal cells with irregularly shaped yellow chromoplastids and oil globules; fragments of epicarp composed of polygonal, quadrangular, rectangular or irregular cells with beaded, yellow, vertical cuticularized walls, the latter up to  $7.6\mu$  in thickness, many of the cells often in parallel series; fragments of the epidermis of seed coat with much contorted, sinuate, lignified stone cells with irregularly thickened walls containing many broad pore canals; fragments of small-celled parenchyma of the endosperm containing tiny aleurone grains, fixed oil globules and occasional monoclinic prisms.

*Moisture.*—One recently ground authentic sample of Tabasco was found to contain 7.6% of moisture.

*Ether Extract.*—The ether extract of one recently ground authentic sample was found to be 20.93% of which 0.92% was volatile and 20.01% was non-volatile. The non-volatile ether extract of 10 samples of Tabasco obtained from different crops ran from 17.25% to 20.25% with an average of 18.1%.

*Ash.*—The total ash of one recently obtained sample of authentic ground Tabasco was 4.57% and the acid-insoluble ash, 0.08%. The total ash on 10 samples of ground Tabasco obtained from different crops ran from 3.5% to 5.1% with an average of 4.1%. The acid-insoluble ash of these ran from 0.08% to 0.10% with an average of 0.94%.

#### PUNGENCY TESTS.

The U. S. P. XI pungency test was carried out with the three varieties of Louisiana Capsicum and a control which represented recently ground African Capsicum received from S. B. Penick & Co. on a series of three individuals with the following results:

La. Longs	Positive 0	Negative 3
La. Sports	Positive 1	Negative 2
Tabasco	Positive 2	Negative 1
African Capsicum	Positive 2	Negative 1

A second series of tests was run on 25 individuals, using the same preparation employed in the U. S. P. pungency test, with the following results.

La. Longs	Positive 0	Negative 25
La. Sports	Positive 8	Negative 17
Tabasco	Positive 16	Negative 9
African Capsicum	Positive 19	Negative 6

It is apparent from the results of the first series of U. S. P. tests that the samples of African and Tabasco peppers met the pungency requirement, 2 out of 3 individuals responding positively.

In the second series of tests in which 25 persons were used, the U. S. P. African Capsicum alone met the official requirement with Tabasco coming within a fraction of an individual from meeting it.

If, however, the group of 25 individuals were to be divided into groups of 3 consecutive persons and the results analyzed, it was found that in 2 groups to which the preparation of African Capsicum had been administered only 1 out of 3 individuals met the pungency test, whereas in one group to which the preparation of La. Sport Capsicum had been administered all three responded positively to the test.



The variability of sensitivity of humans to the Capsicum pungency test is 50:1, according to Crosbie and Munch (5), who found it necessary to standardize the test animal against piperine or capsaicin.

It is, accordingly, evident that owing to the great variability of sensitivity of individuals to the present U. S. P. pungency test, this test is not reliable as a means for evaluating Capsicum.

When powdered Tabasco and La. Sport Capsicum were tasted by the tip of the tongue by 12 non-standardized individuals they appeared as pungent as powdered African Capsicum.

It would seem urgent that either the U. S. P. method be revised by first standardizing humans or that a chemical test probably based on the capsaicin content be devised as a standard of assay for this drug.

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### THE EFFECT OF PEPTONE ON THE RESISTANCE OF STAPHYLOCOCCUS AUREUS.\*

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It is a well-known fact that the different brands of commercial peptone vary as to their chemical composition. Different batches of the same brand of peptone will also vary chemically, dependent, probably, on the degree of digestion. We have some evidence to the effect that there is a correlation between the state of digestion and the nutritive value of peptone, but exactly what chemical factors are responsible for these differences is not known at this time.

The *growth-promoting* value of the different peptones is not the only factor to be considered. Different peptones may give equally luxuriant growth of certain bacteria and yet the condition of these organisms will vary considerably. In making diphtheria toxin, tetanus toxin, etc., certain peptones will give good growth of the organisms in broth, but it is usually found that one certain peptone will give toxin of a higher potency than the others. For this reason, we cannot be guided entirely by the growth-promoting property of peptones in choosing the brand to be used in bacteriological work. For plate counting in milk and water examination, however, the peptone chosen must possess maximum growth-promoting properties and give the maximum number of colonies. The condition of the organisms after they have grown on the plates is of no importance so long as the colonies are large enough to be easily counted.

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