to rise spontaneously to somewhat below room temperature, there being no necessity to apply strong heating measures, such as placing the container in an oven or in hot water. Cod liver oil apparently suffers no damage from this alternate "freezing" and "thawing," but when cloudy, precipitated or thickened or congealed by cold the product is less sightly and, consequently, should not be exhibited for sale purposes if it should happen to have been allowed to get into this condition.

While the ability of a cod liver oil to remain clear at extremely low temperatures is of value as one of the points of pharmaceutical elegance, proper consideration must also be accorded to other important characteristics such as vitamin potency, palatability, attractiveness of color, inoffensiveness of odor, freedom from rancidity and excessive acidity and peroxides, absence of bleaching or other chemical agents, uniformity of potency and physical characteristics and stability.

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A COMPARATIVE STUDY OF THE COMMERCIAL VARIETIES OF MILD SILVER-PROTEIN, U. S. P. X.*

BY FLORIN J. AMRHEIN.[1]

Preparations of Mild Silver-Protein as found commercially may be grouped as follows: (A) Mild Silver-Protein, U. S. P. X, (B) Proprietary brands of Mild Silver-Protein U. S. P., (C) Proprietary brands of related substances containing silver in colloidal form. Mild Silver-Protein, U. S. P. X, is defined as follows: Silver rendered colloidal by the presence of or combination with protein. It contains not less than 19 per cent and not more than 25 per cent of silver (Ag).

Group (A) preparations are usually labeled as follows: Mild Silver-Protein, U. S. P. X, containing not less than 19 per cent and not more than 25 per cent of silver. Group (B) preparations are generally labeled as follows: . . . . , A brand of Mild Silver-Protein U. S. P. X, containing from 19 per cent to 23 per cent (or 19 to 25 per cent) of silver in colloidal form. Group (C) preparations are usually labeled with a coined name, and no statement is made concerning their composition.

For the purpose of this study the following preparations were selected, Group (A), Mild Silver-Protein, U. S. P. Group (B) Silver Nucleinate, Silvol and Solargentum. Group (C) Argyrol, Lunargen and Silver Nucleinate.

In this study the author makes no claims concerning the comparative therapeutic value of these preparations. The work includes the description and physical properties of these substances together with identity tests and assays for silver.

COMPARISON OF DESCRIPTION AND PHYSICAL PROPERTIES.

Mild Silver-Protein, U. S. P.—Dark brown or almost black shining scales or granules. It is odorless, and slightly hygroscopic. It is soluble in water, but almost insoluble in alcohol, chloroform and ether.

Silver Nucleinate, Mild Silver-Protein, U. S. P.—Brownish black to black shining scales. It is odorless, hygroscopic in moist air and efflorescent in dry air. It is soluble in water, but insoluble in alcohol, chloroform and ether.

* Scientific Section, A. PH. A., Toronto meeting, 1932.

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Silvol, Mild Silver-Protein, U. S. P.—Black shining scales and granules with a greenish iridescence. It is soluble in water, but almost insoluble in alcohol, chloroform and ether. It is hygroscopic in moist air.

Solargentum, Mild Silver-Protein, U. S. P.—Black shining scales or granules. It is odorless, hygroscopic in moist air and slightly efflorescent in dry air. It is soluble in water, but almost insoluble in alcohol, chloroform and ether.

Silver Nucleinate, Not U. S. P.—Very fine shining granules. It is odorless, hygroscopic in moist air. It is soluble in water, but almost insoluble in alcohol, chloroform and ether.

Lunargen, Not U. S. P.—Black shining scales. It is odorless, hygroscopic in moist air. It is soluble in water, but almost insoluble in alcohol, chloroform and ether.

Argyrol, Not U. S. P.—Dull black irregular tabular pieces. It is odorless, very hygroscopic in moist air and efflorescent in dry air. It is soluble in water, but almost insoluble in alcohol, chloroform and ether.

In each instance it was observed that when these preparations were exposed to moist air they all absorbed moisture. The amount of moisture absorbed depended upon the length of time that they were exposed and also upon the relative humidity present in the air. When the relative humidity was comparatively, low, *i. e.*, between 15 and 20 per cent, these preparations were slightly efflorescent.

TESTS FOR IDENTITY.

About 0.1 Gm. of each preparation was ashed in a porcelain dish, the warm residue treated with nitric acid, and diluted with 10 cc. of distilled water. The addition of hydrochloric acid produced a white precipitate which dissolved in an excess of ammonium hydroxide test solution. All of the preparations gave a positive reaction with this test.

Two cc. of an aqueous solution of sodium chloride (1 in 100) were treated with 10 cc. of an aqueous solution of each preparation (1 in 100), no turbidity was produced by any of the preparations under test.

WITH FERRIC CHLORIDE TEST SOLUTION.

Sample No.		
1.	Mild Silver-Protein, U. S. P.	Curdy, light, flesh-colored precipitate. Olive-green, opaque, supernatant liquid
2.	Silver Nucleinate, U. S. P.	Light, flesh-colored precipitate. Greenish yellow, opaque, supernatant liquid
3.	Silvol	Curdy, flesh-colored precipitate. Brown, opaque, supernatant liquid
4.	Solargentum	No precipitate formed. Greenish brown, opaque, supernatant liquid
5.	Silver Nucleinate, not U. S. P.	Cream-colored precipitate. Brown, supernatant liquid
6.	Lunargen	White precipitate. Olive-green, translucent, supernatant liquid
7.	Argyrol	Curdy, gray precipitate, turning lavender within one minute. Olive-green, transparent, supernatant liquid

In all of the above tests the dark color of the original silver-protein solution was discharged by the ferric chloride test solution.

WITH MERCURIC CHLORIDE TEST SOLUTION.

Sample No.	
1.	Milky, opalescent solution
2.	Milky, opalescent solution
3.	Light blue, slightly opalescent solution
4.	Slightly opalescent solution
5.	Three-fourths of a test-tube of a gelatinous precipitate, clear supernatant liquid
6.	Milky opalescent solution
7.	Fine, milky suspension, opaque, supernatant liquid

In all of the above tests the dark color of the original silver-protein solution was discharged by the mercuric chloride test solution.

WITH ESBACH'S SOLUTION.

Sample No.	
1.	Brown precipitate
2.	Brownish black precipitate
3.	Curdy, brown precipitate
4.	Curdy, dark brown precipitate
5.	Black to brownish precipitate
6.	Curdy, brownish black precipitate
7.	Black precipitate, mirror formed on sides of tube

WITH IODINE TEST SOLUTION.

Sample No.	
1.	Light brown precipitate
2.	No precipitate, orange liquid
3.	No precipitate, orange liquid
4.	No precipitate, orange liquid
5.	Light brown precipitate
6.	No precipitate, brownish red liquid
7.	One-half inch of yellow precipitate in tube, orange liquid

WITH MERCURIC NITRATE TEST SOLUTION.

Sample No.	
1.	Yellowish white flocculent precipitate. Clear, supernatant liquid
2.	Yellow flocculent precipitate. Opaque, supernatant liquid
3.	Yellow flocculent precipitate. Colorless, supernatant liquid
4.	Yellowish, resinous-like precipitate, clings to sides of tube. Opalescent, supernatant liquid
5.	Yellowish white precipitate. Clear supernatant liquid
6.	Yellowish white flocculent precipitate. Colorless, supernatant liquid
7.	Slight white flocculent precipitate. Colorless, supernatant liquid

WITH MILLON'S REAGENT.

Sample No.	
1.	Cream-colored precipitate. Opaque, supernatant liquid
2.	Cream-colored precipitate. Clear, pink-colored, supernatant liquid
3.	Pink-colored precipitate. Clear, supernatant liquid
4.	Pink-colored, resinous precipitate. Opalescent, pink-colored, supernatant liquid
5.	Cream-colored precipitate. Opalescent, pink-colored, supernatant liquid
6.	White, curdy precipitate. Pink, supernatant liquid
7.	Cream-colored precipitate. Opalescent, milky, supernatant liquid

WITH NESSLER'S REAGENT.

Sample No.	
1.	Dirty brownish black solution
2.	Same as above
3.	Same as above
4.	Same as above
5.	Same as above
6.	Same as above
7.	Same as above

The above tests were of little value as identity tests.

Gas Formation.—When tested by the method described under Strong Silver-Protein, U. S. P. X, page 63, 0.8 cc. of an aqueous solution of each of the preparations under test (1 in 20) permitted abundant gas formation.

The writer has observed that many manufacturers of Mild Silver-Protein and other closely related substances have cautioned users of their products by stating that the product is hygroscopic and that it should be kept in sealed containers. It has been found by actual determination that when these products are purchased in original sealed bottles that the moisture content varies over a relatively wide

range for different lots of the same product. In determining the moisture content in material from opened bottles it has been found that the moisture content may reach as high as 12 per cent without the contents becoming sticky.

Determination of Moisture.—Accurately weigh about 2 Gm. of the sample in a tared porcelain evaporating dish. Dry at a temperature of 100° C. for twelve hours, and weigh. Continue the drying and weighing at half-hour intervals until the weight is constant. The weight was considered constant when the loss was not greater than one mg. in the last two weighings.

RESULTS.

Sample.	Moisture.
Mild Silver-Protein, U. S. P.	6.80%
Silver Nucleinate, U. S. P.	5.62%
Silvol	5.37%
Solargentum	7.23%
Silver Nucleinate, not U. S. P.	7.60%
Lunargen	4.05%
Argyrol	5.39%

Determination of Total Ash.—The residue from the moisture determination was carefully ignited at dull red heat until free from carbon and until a grayish white ash was obtained. The per cent of total ash was calculated from the weight of sample taken in the moisture determination.

RESULTS.

Sample.	Total Ash.
Mild Silver-Protein, U. S. P.	30.01%
Silver Nucleinate, U. S. P.	28.71%
Silvol	28.81%
Solargentum	29.12%
Silver Nucleinate, not U. S. P.	26.09%
Lunargen	28.00%
Argyrol	35.74%

Determination of Acid-Insoluble Ash.—The total ash was digested with 25 cc. of nitric acid test solution on a water-bath for one hour. The insoluble material was then collected on a tared filter paper, washed free from acid, ignited in the crucible in which the sample was ashed and then dried to constant weight in a drying oven at 100° C., and weighed. Then the per cent of acid-insoluble ash was calculated from the weight of sample taken in the ash determination. In almost every instance the acid-insoluble ash appeared steel gray to black on the filter paper.

RESULTS.

Sample.	Acid-Insoluble Ash.
Mild Silver-Protein, U. S. P.	0.40%
Silver Nucleinate, U. S. P.	0.47%
Silvol	0.17%
Solargentum	1.06%
Silver Nucleinate, not U. S. P.	0.36%
Lunargen	0.03%
Argyrol	0.78%

Calculations of Acid-Soluble Ash.—The acid-soluble ash was calculated subtracting the per cent of acid-insoluble ash from the per cent of total ash found.

RESULTS.

Sample.	Acid-Soluble Ash.
Mild Silver Protein, U. S. P.	29.61%
Silver Nucleinate, U. S. P.	28.24%
Silvol	28.64%
Solargentum	28.06%
Silver Nucleinate, not U. S. P.	25.73%
Lunargen	27.97%
Argyrol	34.96%

Determination of Water-Soluble Ash.—The ash obtained from about 2 Gm. of sample was digested on a water-bath with 50 cc. of distilled water for several hours. It was then filtered into a 100-cc. volumetric flask and cooled; the beaker, dish and residue on the filter paper were washed with enough distilled water to make exactly 100 cc. A 20-cc. portion of the well-mixed solution was then evaporated in a tared porcelain dish on a water-bath and dried to constant weight and the amount of water-soluble ash calculated. The water-soluble ash was an opaque-white residue with a slight pearly lustre. The residue effervesced slightly with dilute mineral acids.

RESULTS.

Sample.	Water-Soluble Ash.
Mild Silver-Protein, U. S. P.	11.12%
Silver Nucleinate, U. S. P.	9.62%
Silvol	8.71%
Solargentum	9.53%
Silver Nucleinate, not U. S. P.	3.83%
Lunargen	9.88%
Argyrol	15.91%

QUALITATIVE EXAMINATION OF WATER-SOLUBLE ASH.

Sample.	Metallic Ions.	Acidic Ions.
Mild Silver-Protein, U. S. P.	Sodium, Potassium	Chlorides, sulphates, carbonates
Silver Nucleinate, U. S. P.	Sodium, Potassium	Chlorides (trace), sulphates, carbonates
Silvol	Sodium, Potassium	Chlorides (trace), sulphates, carbonates
Solargentum	Sodium, Potassium	Chlorides (strong), sulphates, carbonates
Silver Nucleinate, not U. S. P.	Sodium, Potassium	Chlorides, sulphates, carbonates
Lunargen	Sodium, Potassium	Chlorides, sulphates, carbonates
Argyrol	Sodium, Potassium	Chlorides (strong), sulphates, carbonates (strong)

Determination of the Alkalinity of the Water-Soluble Ash.—A 20-cc. portion of the solution of the water-soluble ash was titrated with 0.1 *N* H_2SO_4 V.S., using methyl orange as the indicator. The number of cc. of 0.1 *N* H_2SO_4 V.S., required for neutralization, was calculated on the basis of 1 Gm. of the original sample.

RESULTS.

Sample.	Cc. of 0.1 *N* H_2SO_4 per Gm. of Sample.
Mild Silver-protein, U. S. P.	18.75
Silver Nucleinate, U. S. P.	16.20
Silvol	13.47
Solargentum	14.75
Silver Nucleinate, not U. S. P.	5.75
Lunargen	16.71
Argyrol	25.72

Determination of Chlorine in the Water-Soluble Ash.—The per cent of chlorine in the water-soluble ash was determined by titration using $AgNO_3$ V.S. (1 cc. = 0.0005 Gm. of Cl), with potassium chromate as the indicator. A 20-cc. portion of the solution of the water-soluble ash described above was used for the determination.

RESULTS.

Sample.	Per Cent of Chlorine.
Mild Silver-Protein, U. S. P.	0.13%
Silver Nucleinate, U. S. P.	0.08%
Silvol	0.09%
Solargentum	0.39%
Silver Nucleinate, not U. S. P.	0.13%
Lunargen	0.05%
Argyrol	0.33%

Determination of Sulphates as SO_3 in the Water-Soluble Ash.—The per cent of sulphuric anhydride in the water-soluble ash was determined by precipitation with barium chloride T.S., in the presence of hydrochloric acid T.S. The amount of barium sulphate obtained was dried to constant weight and calculated to per cent of sulphuric anhydride.

RESULTS.

Sample.	Per Cent of SO_3.
Mild Silver-Protein, U. S. P.	0.18%
Silver Nucleinate, U. S. P.	0.11%
Silvol	0.17%
Solargentum	0.22%
Silver Nucleinate, not U. S. P.	0.11%
Lunargen	0.11%
Argyrol	0.17%

Determination of Silver Content, U. S. P. X, Assay.—Ignite about 1 Gm. of Mild Silver-Protein accurately weighed in a porcelain crucible until all of the carbon is burned off. Transfer as much as possible of the residue to a beaker, add to the crucible 5 cc. of nitric acid, warm to dissolve any adhering silver, and transfer the solution to the beaker with the aid of a little distilled water. Cover the beaker, and heat on a water-bath until all of the metallic silver is dissolved, adding a little more nitric acid, if necessary. Filter into a flask, wash the insoluble residue thoroughly with distilled water, cool and dilute with distilled water, if necessary, to about 50 to 75 cc. Add 2 cc. of ferric ammonium sulphate T.S., and titrate with tenth-normal potassium thiocyanate V.S. Each cc. of tenth-normal potassium thiocyanate corresponds to 0.01079 Gm. of silver.

RESULTS.

Sample.	Per Cent of Silver.
Mild Silver-Protein, U. S. P.	19.15%
Silver Nucleinate, U. S. P.	18.87%
Silvol	19.89%
Solargentum	18.84%
Silver Nucleinate, not U. S. P.	21.72%
Lunargen	18.57%
Argyrol	19.75%

Modified U. S. P. X, Assay. (A).—Ignite about 1 Gm. of the Mild Silver-Protein, accurately weighed in a porcelain crucible, until all of the carbon is burned

off. Then moisten the residue in the crucible with 1 cc. of sulphuric acid and 5 cc. of nitric acid and 10 cc. of distilled water. Cover the crucible and digest for one-half hour on a water-bath. Filter the contents of the crucible into a flask and wash the crucible and residue on the filter paper with enough distilled water to make about 100 cc. Then add 2 cc. of ferric ammonium sulphate T.S., and titrate with tenth-normal potassium thiocyanate V.S.

RESULTS.

Sample.	Per Cent of Silver.
Mild Silver-Protein, U. S. P.	19.04%
Silver Nucleinate, U. S. P.	19.08%
Silvol	19.79%
Solargentum	19.08%
Silver Nucleinate, not U. S. P.	21.57%
Lunargen	18.72%
Argyrol	20.07%

Modified U. S. P. Assay for Silver. (B).—Removing Water-Soluble Ash.—Ignite about 1 Gm. of Mild Silver-Protein accurately weighed in a 50-cc. porcelain crucible until all of the carbon is burned off. When cool, add 30 cc. of distilled water and digest for $^1/_2$ hour on a water-bath. Then filter, and wash the crucible and residue into a filter paper with 70 cc. more of distilled water. The filtrate may be discarded. The residue and filter paper are then ignited in the same crucible until all of the carbon of the filter paper is burned off. The residue is then digested with 5 cc. of nitric acid in the same crucible, and then diluted with 10 cc. of distilled water, filtered into a flask and titrated with tenth-normal potassium thiocyanate V.S., using 2 cc. of ferric ammonium sulphate T.S., as an indicator.

RESULTS.

Sample.	Per Cent of Silver.
Mild Silver-Protein, U. S. P.	19.10%
Silver Nucleinate, U. S. P.	19.10%
Silvol	19.91%
Solargentum	19.10%
Silver Nucleinate, not U. S. P.	21.57%
Lunargen	18.68%
Argyrol	20.18%

In comparing the three assays the author prefers Modification B. In this assay all interfering substances are removed first and the silver is set free. Modification A gives results that are comparable with Modification B. Either assay apparently gives results that are closer than the present U. S. P. assay.

In concluding, the author suggests that the Revision Committee of the U. S. P. XI consider the inclusion of the following to the Monograph under Mild Silver-Protein:

1. A statement of moisture content.
2. A statement of ash content.
3. A revision of the allowable limits for silver.

Suggestion No. 3 is strongly recommended in view of the fact that the results obtained in 80 or 90 assays for silver on preparations of this type disclosed but one sample that contained over 21% of silver.

It is also suggested that the modified assays for silver be studied further and comparisons made with the present U. S. P. assay since the soluble chlorides present in these preparations interfere to some extent with the procedure of the latter assay

BIBLIOGRAPHY.

Jour. A. Ph. A., 7 (1918), 677, 992.
Yearbook, A. Ph. A., 9 (1920), 420.
American Journal of Pharmacy, 96 (1924), 594.
United States Pharmacopœia, Tenth Revision, pages 63 and 64.
Jour. A. Ph. A., 15 (1926), 277.
American Journal of Pharmacy, 103 (1931), 42.

MICROBIOLOGY VERSUS BACTERIOLOGY. PART II.

BY FANCHON HART.*

The curriculum content and teaching methods as set forth in a previous paper,[1] by the author, endeavored to differentiate between the aims and objectives of two related courses of study. In this paper I hope to make clear the specific advantages of each course to the student, the graduate and the pharmaceutical practitioner.

Although both bacteriology and microbiology are given at the College of Pharmacy of Columbia University and although our student body consists of candidates for the Ph.G. as well as for the B.S. degrees, our major purpose as a school of pharmacy is the adequate training for the retail dispenser of pharmaceuticals. For this reason I shall consider first, the course in Microbiology which is a compulsory subject for the prospective graduate in pharmacy.

Microbiology was introduced into the Ph.G. curriculum to meet the more recent needs for a knowledge of community hygiene and the prevention and control of the common communicable diseases.

The concept of the pharmacist educating the public is not of recent origin and its intrinsic value has long been recognized by the profession. A greater knowledge of prophylaxis has fortunately brought to the pharmacist additional opportunities for purposeful health guidance and demonstrations of worthy citizenship. A neighborly interest in the well-being of those he comes in contact with is easily recognized. Rapport having once been established, the confidence of the community is in the hands of the neighborhood druggist. It is within his power to improve sanitary conditions around him, both outside of, as well as within the homes, if he apply with sympathy and consideration the knowledge gained from the course in microbiology. This is more than a foundational, orientational or single subject-matter course. The establishment of desirable attitudes, the strengthening of personalities, and a wish to help human kind, are obvious results of the educational experiences gained from its broad social and economic relationship to life around us.

It is of the utmost importance to the pharmacist that he know the phenomenon of immunity; the Board of Health regulations concerning fumigation; incubation and quarantine. He can do much to establish and preserve sanitary conditions and by so doing, coöperate with the departments of health and sanitation.

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[1] Part I, 21 (1932), 675.