Conversion of Liquid Laboratory Wastes to a Solid Form: Precipitating Osmic Acid with Tannic Acid and Gluten, and Embedding Cacodylic Acid in Starch Paste

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ABSTRACT

Laboratory wastes containing glutaraldehyde, paraformaldehyde, osmic acid and cacodylic acid were mixed with tannic acid and then with gluten. The osmium/tannin/gluten/aldehyde complex thus precipitated was separated as a cake by paper filtration. The filtrate containing cacodylic acid was supplemented with starch and warmed. This embedded filtrate in starch paste was air-dried together with the filter cake, and stored in a desiccator. The method also appears useful for storage of similar laboratory wastes.

Heavy metals and organic substances, such as osmic acid, silver nitrate, cacodylic acid and dianinobenzidine, are routinely used as fixatives, dyes or buffers in laboratories (1–4). Wastes containing these agents are harmful or contaminate the environment, and must be stored. This paper describes a method for storing such harmful wastes in a solid, dry form. It consists of separating the heavy metals with tannic acid and gluten from the wastes, and embedding the wastes or the filtrate in starch paste.

Samples (50 ml) of laboratory wastes containing 0.5–1.5% osmic acid, 2.0–4.0% paraformaldehyde, 0.5–1.5% glutaraldehyde and 1.5–2.0% cacodylic acid (osmic acid/aldehyde/cacodylic acid wastes) were mixed with 25–30 ml of 10% tannic acid solution. This product was then mixed with 25–30 ml of 20% gluten suspension, and filtered using a filter paper (No. 2, Advantec Toyo, Tokyo, Japan).

The filter cake was air-dried, and stored in a desiccator. The filtrate was supplemented with 10–15 g (15–20%, w/v) of starch (potato), and warmed in a hot water bath (80–90°C). The filtrate thus embedded in starch paste was air-dried, and stored in the desiccator.

Tannic acid, gluten, and starch (potato) were purchased from Katayama Chemical, Osaka, Japan.

The osmic acid/glutaraldehyde/paraformaldehyde/cacodylic acid wastes were black, since the osmic acid in the wastes was partially reduced (Fig. 1A).

Tannic acid produced neither a deposit nor precipitate in the wastes (Fig. 1B). However, successive supplement of gluten produced marked precipitates (Fig. 1C). These precipitates were easily separated as filter cakes by paper filtration (Fig. 1, D and E). The filtrate obtained by this filtration was clean and transparent (Fig. 1D). The starch in the filtrate was readily converted into the paste by warming (Fig. 1F).

The filter cake and starch paste-embedded filtrate were easily dried in air (Fig. 1, E and G), and can be stored as solid, dry materials in a desiccator.

Osmic acid, cacodylic acid, glutaraldehyde and paraformaldehyde are routinely used for fixation of biological specimens. However, there are few methods for storing the wastes of these toxic agents (5).

This paper described a tannin-gluten method for the separation of osmic acid as a filter cake, consisting of an osmium/tannin/gluten complex. Glutaraldehyde and paraformaldehyde are contained in the filter cake since they react with gluten. Cacodylic acid, which does not react with tannic acid and gluten, is embedded in the starch paste.

Sufficient amounts of tannic acid and gluten should be used. When precipitation of osmium is insufficient, the filtrate has a black tint. In such
cases, more tannic acid and gluten can be added. A sufficient amount of starch should also be used to obtain a hard starch paste.

Tannic acid also reduces ionized copper, iron, chromium, manganese, mercury, silver, gold and other heavy metals, including lead and uranium (1). Thus, our tannin-gluten method is equally useful for precipitating other heavy metals, except platinum which does not react with tannic acid (1). Gelatin, peptone, albumin and other peptides or proteins (2, 3) can be used as a substitute for gluten. Japanese isinglass or agar-agar is useful as a substitute for starch.

Starch-embedding can be used alone. In preliminary experiments, wastes containing chloroplatinic acid (see above), diaminobenzidine or colloidal iron were readily embedded in starch paste by warming in a hot water bath (80–90°C). In this embedding, supplement of activated carbon prior to the warming is useful since this carbon adsorbs chloroplatinic acid, diaminobenzidine and also colloidal iron.

Dried samples of the filter cake and starch-embedded filtrate may be burned; however, this requires careful considerations for the environment.

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REFERENCES
