could have been derived from the disappearing unconjugated C^{14} bilirubin. The actual figure is probably considerably less since it is known that some of the unconjugated C^{14} bilirubin is metabolised and not converted to conjugated C^{14} bilirubin. Only a small error is therefore incurred in the calculation of the half-life of conjugated bilirubin in the bile duct ligated rats. Whether the simultanous retention of conjugated bile salts in this preparation influences the half life of conjugated bilirubin cannot be established without pure speciments of the pigment.

It is not known whether conjugated and unconjugated bilirubin are present in tissues in the same or different proportions as those found in plasma. It has, therefore, not been possible to calculate the size of the total miscible bilirubin pool from the data obtained in this study.

Summary. Unconjugated (C^{14})-bilirubin was administered intravenously to rats with complete biliary obstruction. The plasma disappearance curves of both the conjugated and unconjugated (C^{14})-bilirubin fractions were determined using a modified Weber and Schalm technique. More than 70% of the (C^{14})-bilirubin radioactivity in the plasma was present as conjugated (C^{14})-bilirubin after 15-30 minutes of injecting the unconjugated label. The biological half life of unconjugated (C^{14})-bilirubin averaged 53 hours while that of the conjugated form 34 hours. This difference could be explained by the clearance of conjugated (C^{14})-bilirubin by the kidney.

1. Ostrow, J. D., Jandl, J. H., Schmid, R., J. Clin. Invest., 1962, v41, 1628.

2. Weber, A.Ph., Schalm, L., Clin. Chim. Acta, 1962, v7, 805.

3. Ostrow, J. D., Hammaker, L., Schmid, R., J. Clin. Invest., 1961, v40, 1442.

4. Ibrahim, C., Watson, C. J., Gastroenterology, 1964, v46, 299.

5. Cotlove, E., J. Appl. Physiol., 1961, v16, 764.

6. Jeffay, H., Alvarez, J. Analyt. Chem., 1961, v33, 612.

7. Schmid, R. Hammaker, L., J. Clin. Invest., 1963, v42, 1720.

Received September 16, 1956. P.S.E.B.M., 1966, v124.

Effect of Cold Dilute Saline Ingestions on Evaporative Weight Loss of Heat-Exposed Resting Men.* (31738)

LEO C. SENAY, JR. (Introduced by F. E. Franke)
Department of Physiology, St. Louis University School of Medicine, St. Louis, Mo.

When man is exposed to hot environments, any circumstance that reduces his ability to sweat is considered detrimental to his physical well being. One factor that has not been investigated is the effect of heat content of ingested fluids on human temperature regulation. Brief studies(1,2) have been reported on palatability of water at various temperatures but there is a divergence of opinion based on subjective evidence as to what the temperature of ingested fluids should be when man is exposed to warm environments. Environmental studies reflect this condition and when water or other fluids were used to rehydrate heat exposed individuals, temperature of ingested fluids has been ignored, definitely stated or vaguely indicated. Basic to this varied treatment of ingested fluid temperature is the assumption that there is little or no detectable difference in performance following cold or warm water ingestion(3). Such reasoning is based on the small amount of heat used to raise the temperature of ingested cold liquids to that of the body. During a series of heat exposure experiments we obtained data which indicate that this concept is an oversimplification.

Methods. Three nude non-acclimatized male medical students were exposed for 12 hours to 43 C D.B. and 29 C W.B. in order to

* Supported by USPHS Grants HE-07075 and HE 1 K3 25,110.

TABLE I

Subject	Ingested fluid	Original body wt (kg)	Evaporative wt loss (kg)	Urine loss (l)	Rectal temp (°C) 2nd hr	Rectal temp (°C) 12th hr	Δ Rectal temp (°C)
1	None	90.26	3.93	.370	36.89	38.56	1.67
	Cold saline	89.79	3.25	.867	36.55	36.89	.34
	Warm saline	88.19	3.80	.935	36.67	36.78	.11
2	None	75.63	3.12	.405	37.00	37.67	.67
	Cold saline	75.74	2.86	1.198	36.67	37.33	.66
	Warm saline	75.76	3.25	.851	36.89	37.00	.11
3	None	83.15	3.67	.438	37.00	37.67	.67
	Cold saline	81.72	3.24	.883	36.78	37.22	.44
	Warm saline	79.56	3.86	.824	36.89	37.22	.33

compare rates of evaporative weight loss when rehydrated at hourly intervals (0.1% saline equal to weight loss) and when they received no fluids for the entire heat exposure period. Body weights (Buffalo Beam Balance) were taken hourly and rectal temperatures were taken at 2-hour intervals from the second to the twelfth hour of heat exposure. The same calibrated clinical thermometer was used for all subjects. Subjects were restricted to a canvas cot and stood up only to be weighed or to urinate.

Results. Inadvertently, rehydration was accomplished with saline that had been cooled to 8-10 C. As shown in Table I, subjects rehydrated with cold saline, lost less weight by evaporation than when they were dehydrated. Rehydration experiments were repeated a second time using warm (37 C) 0.1% saline to maintain body weight. Evaporative weight loss increased 0.39 l to 0.62 l over that recorded during cold saline ingestion whereas amounts of urine excreted did not show any consistent change. In addition, increases in rectal temperatures during the final 10 hours of heat exposure were greater with cold than with warm saline ingestion (Table I).

Discussion. Deficits in evaporative weight loss produced by cold saline ingestion could not be accounted for by equating calories needed to warm the ingested fluid to body temperature with an equal caloric reduction in sweat production (1 g of evaporative loss = 0.58 kg cal). Reductions in evaporative weight loss during experiments with cold saline ingestion were 3-4 times that necessary to warm the ingested fluid to 37 C. The net result of such evaporative deficits was heat storage as reflected by greater increases of rectal temperatures when cold rather than warm saline was ingested (Table I).

To account for the greater heat storage during cold saline ingestion, evaporative deficits need only to have been in the range of 50-100 g of sweat. Since reduction in evaporation was greater than this (Table I), it is suspected that sweat secreted by our resting non-acclimatized subjects who ingested warm 0.1% saline was not totally used for body cooling—*i.e.*, a portion of the sweat dripped rather than evaporated from their bodies. This is supported by the findings of Wyndham *et al*(4).

Summary. Ingestion of saline warmed to body temperature was accompanied by secretion of sweat that was more than ample to maintain body temperature. Ingestion of cold saline reduced sweat production and increased body heat storage. Since urine formation showed no consistent volume changes, increased production or action of antidiuretic hormone does not appear to be involved in this reduction of sweat secretion.

1. Adolph, E. A. and Associates. Physiology of Man in the Desert. Interscience, New York, 1947. pp. 130, 258, 349.

2. Wolf, A. V. Thirst. C. C Thomas, Springfield, 1958, Ch. 3.

3. Bell, C. R., Hellon, R. F., Hiorns, R. W., Nicol, P. B., Provins, K. A., J. Appl. Physiol., 1965, v20, 288.

4. Wyndham, C. H., Morrison, J. F., Williams, C. G., J. Appl. Physiol., 1965, v20, 357.

Received October 11, 1966. P.S.E.B.M., 1967, v124.