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## **An alternate, egg-free radiolabelled meal formulation for gastric emptying scintigraphy**

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## **Abstract**

Tc-99m-radiolabelled scrambled eggs (SE) are most often used as the ingested solid phase for gastric emptying scintigraphy (GES), leading egg-reluctant patients to avoid the examination. We formulated and validated two egg-free alternate meals, in the absence of any commercialized formulation: chocolate mug-cake (MC) and scrambled tofu (ST).

Six healthy volunteers underwent GES after ingesting Tc-99m-radiolabelled MC, ST or SE. Images were acquired and interpreted resulting in the calculation of a gastric retention index that did not change significantly between formulations (% of overtime variation to SE: MC  $7.75\pm 7.1\%$ ; ST  $7.17\pm 5.8\%$ ;  $P=0.6618$ , *ns*), suggesting MC and ST as interesting egg-free alternatives.

**Keywords :** gastroparesis, gastric emptying scintigraphy, eggs alternative, Tc-99m.

## Figure 1 legend

The latest guidelines define gastric emptying scintigraphy (GES) as the gold standard for the diagnosis of gastroparesis (1). The Society of Nuclear Medicine recommends a standardized meal with radiolabeled scrambled eggs (SE) as solid-phase (2). Our services regularly encounter patients reluctant to classic egg-based radiolabeled formulations for gastric emptying scintigraphy, mainly due to new eating habits and sociocultural matters, leading to exam cancellations or non-interpretability. Alternatives have already been tested as Liquide Ensure<sup>®</sup> (3) or oatmeal (4) but not completely satisfying, the first being a liquid-phase and the latter being much less palatable for patients suffering of a loss of appetite. Per the absence of recommendation and poor literature for this purpose, we aimed at formulating two egg-free and soy-lecithin-based alternate radiolabelled meals: microwave-baked chocolate mug-cake (MC) and a scrambled tofu (ST), and we evaluated these meals in terms of 1) stability of the radiolabeled phase; 2) comparability of the results expressed as gastric retention index (GRI, %) for interpretation; 3) caloric profile; 4) palatability.

Six healthy volunteers (4 females aged  $25\pm 2$  and 2 males aged  $27\pm 3$ ) underwent GES after ingesting MC, ST and SE radiolabelled with 37MBq Tc-99m sulphur colloids, on 3 consecutive days. Meals were prepared by the same person during the study period. The subjects were fasted overnight and the meal was consumed in 10min. Radiochemical purity of Tc-99m sulphur colloids was  $\geq 95\%$ . Images were acquired 10min, 30min, 1h, 2h, 3h and 4h after ingestion and were interpreted independently by two experienced, blinded nuclear medicine physicians. A GRI was calculated for each time point using the Elashoff curve fit method, as previously described and commonly used for gastric emptying delay diagnosis (5). A two-way ANOVA test was used to compare GRI obtained with the three formulations. Spearman correlation test followed by linear regression were used between GRI obtained

respectively with MC or ST, and SE.  $P < 0.05$  indicated statistical significance.

**Fig. 1A** shows GRI did not change significantly between formulations (% of overtime variation to SE: MC  $7.75 \pm 7.1\%$ ; ST  $7.17 \pm 5.8$ ;  $P = 0.6618$ , *ns*, top). The corresponding GES images obtained in a representative healthy volunteer with both tested formulations were overall similar to the control meal (bottom).

**Fig. 1B** shows significant positive correlations between GRI as obtained with SE or MC (top,  $R^2 = 0.9969$ ,  $P = 0.0028$ ) and as obtained with SE or ST (bottom,  $R^2 = 0.9947$ ,  $P = 0.0028$ ).

The alternate meals were well tolerated by all volunteers, although the MC was largely preferred. SE and MC are equivalent in calories, although the ST is 33% fatter (respectively 422kcal, 425kcal and 653kcal). Both the superimposable GRI time-profiles and their correlations demonstrate MC and ST are interesting as solid phases, compared to liquid or other alternate test formulations that have been recently experimented (3,6,7). Still, MC was widely preferred in matters of taste, and its preparation advantageously relies on a reproducible, safe, and easy microwave-baking protocol, while SE preparation reproducibility is often decried (8).

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