Screening of histopathological slides of visceral organs, viz. heart, kidney, spleen, liver and testis showed normal histological architecture without any significant pathological changes in all animals treated with HCA and HCAL.

Thus, both HCA and HCAL significantly reduced food intake and body weight; however, HCAL showed better effect compared to HCA. Both these compounds were proven to be safe based on biochemical and histopathological analysis. In order to dispel the literature report[14], which stated that HCAL present in HCA salts led to a failure of testicular development, we prepared pure HCAL and studied its effects on the testis and its further impact on their development both with acute and chronic treatment. We have concluded that LD50 of HCAL can be considered as > 5000 mg/kg body wt and classified according to the Globally Harmonized System (GHS) category as either 5 or unclassified, which indicates its non-toxic nature.

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Zinc oxide–neem oil conditioning for improving the quality of the micronutrient fertilizer zinc sulphate heptahydrate

In India, zinc (Zn) deficiency was first reported in rice by Nene[1]; it is now widespread all over the country. The latest report[2] indicates that 49% of Indian soils are deficient in Zn. But good responses of several field and fruit crops to Zn fertilization have been reported from different parts of the country[3,4]. The main causes for the wide-spread emergence of Zn deficiency after the Green Revolution are high crop harvests in intensive crop rotations such as rice–wheat[5] accompanied by imbalanced fertilization with high doses of nitrogen, removal of both grain and straw from the field and little to virtually nil application of organic manures.

Soil application of 10–50 kg ha^{-1} yr^{-1} of zinc sulphate heptahydrate (ZSHH) is the most common method of zinc fertilization. According to the Fertilizer Control Order of 1985 (ref. 6), Government of India, ZSHH should be free flowing, contain 21% Zn and should not have a pH less than 4.0. However, as marketed in India, ZSHH suffers from the following drawbacks in quality: (i) Lump formation during storage; (ii) Lack of free flow; (iii) Free acidity that can be injurious to seeds; (iv) Lesser Zn content due to adulteration.

The present study was undertaken to study some of the above properties in commercially marketed ZSHH in India. For this purpose, samples of ZSHH (fertilizer grade), in 1 kg polypropylene packs, were obtained from three manufacturers.

Conditioning with zinc oxide–neem oil (ZONO) was done by taking 1 kg ZSHH in plastic containers and adding different amounts of neem oil and zinc oxide (ZnO) and thoroughly mixing the contents of the container. A number of batch studies suggested that the best ratio was 970 g ZSHH, 20 g ZnO and 10 g neem oil. The technique finally adopted was as follows: 970 g of ZSHH was taken in a 5 l plastic container, 10 g neem oil was added and the contents were thoroughly mixed by applying the lid on the container and manually shaking it for 15 min. The container lid was removed and 20 g ZnO (99% purity and 90% particles of 32 micron size) was added. The contents were again thoroughly mixed by shaking for 15 min after applying the lid. For larger amounts of ZSHH, seed treating drums can be used – these are easily available at a low cost. Neem oil was used because of its low cost and also because it controls many insect pests; it has chemicals that have nitrification inhibiting properties which increase nitrogen-use efficiency[7].

The ZONO-conditioned ZSHH was then stored in sealed 1 kg polyethylene bags for six months at a temperature of 35 ± 5°C. The ZONO-conditioned ZSHH

Table 1. Zinc concentration and pH of non-conditioned and zinc oxide–neem oil (ZONO) conditioned zinc sulphate heptahydrate (ZSHH)

	Zinc concentration (%)		pH	
Sample	ZSHH	ZONO-conditioned ZSHH	ZSHH	ZONO-conditioned ZSHH
Source 1	22.5	23.5	4.3	5.7
Source 2	22.0	25.0	4.8	5.7
Source 3	20.7	25.5	5.3	5.5

Table 2. Loss of water of hydration on heating from ZSHH and ZONO-conditioned ZSHH

	Loss of water of hydration (%)	
Item	From ZSHH	From ZONO-conditioned ZSHH
Sample		
Source 1	18.9	11.67
Source 2	18.8	12.33
Source 3	17.7	11.11
SEm ±	0.45	0.43
LSD (P = 0.05)	NS	NS
Temperature (°C)		
30	0.0	0.0
35	5.0	0.89
40	25.0	14.89
45	25.0	19.33
SEm ±	0.45	0.43
LSD (P = 0.05)	1.35	1.28

SEm±, Standard error of mean ±; LSD, Least significant difference; NS, Non-significant.

was then tested for loss of water of hydration, Zn concentration and pH (10% solution/suspension) and compared with these properties in non-conditioned ZSHH.

Zn concentration was determined on an atomic absorption spectrophotometer, whereas the pH of a 10% solution or suspension was established on a pH meter. For finding out the loss of water of hydration on heating, 50 g of ZSHH was taken in a porcelain dish and placed in an oven that was maintained at a specific temperature. The temperatures at which the study was made were 30°C, 35°C, 40°C and 45°C. These are the temperatures generally encountered during spring/summer in India when most of the ZSHH is sold for the coming *kharif* (rainy) season crops. That ZSHH loses water of hydration is well documented (http://www.absoluteastronomy.com/topics/hydrate; http://www.answers.com/topic/zinc-sulfate; http://Wikipedia.org/wiki/zinc_sulfate).

The variation in Zn concentration in samples from different manufacturers could be due to adulteration or loss of water of hydration on storage at temperatures above 35°C. Adulteration reduces Zn concentration below the theoretical value of 22.6% for ZSHH. On the other hand, loss of water of hydration leads to an increase in Zn concentration in ZSHH. The theoretical values of zinc content for zinc sulphate hexahydrate, zinc sulphate pentahydrate and zinc sulphate monohydrate are 24.1%, 25.1% and 36.3% respectively. ZONO conditioning increased Zn content in ZSHH (Table 1). This would be expected because the ZnO used for conditioning contained 82% Zn. ZONO conditioning also increased the pH of the 10% solution/suspension of ZSHH by 0.9. This was due to the fact that the pH of the 10% suspension of ZnO was 7.5.

ZONO conditioning of ZSHH significantly reduced the loss of water of hydration on heating (Table 2). This reduction was 82.2% at 35°C, 40.4% at 40°C and 22.7% at 45°C and prevented the formation of lumps even after storage for six months and made the material free flowing. Free acidity in ZSHH was also taken care of as the pH of the ZONO-conditioned ZSHH was 5.5 or above.

Cost of ZONO conditioning:
For each 970 g ZSHH,
Cost of 10 g neem oil
(@ Rs 50/kg) = Rs 0.50
Cost of 20 g ZnO (@ Rs 100/kg)
= Rs 2.00
Cost of processing = Rs 0.25

Total = Rs 2.75

ZSHH is sold at a price ranging from Rs 30 to 40 per kg. Thus, the cost of ZONO conditioning is very little and works out to about 7–9% over the cost of ZSHH. As compared to the cost, the advantages of ZONO conditioning of ZSHH include an increase of 1.0–4.8% in Zn concentration (Table 1) and reduction in lump formation.

The ZONO conditioning developed by us is a simple low cost technique for improving the quality of ZSHH and both farmers and dealers will benefit from it.

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