Nicarbazin is a bimodal salt consisting of two molecules – DNC and HDP. DNC is the active component and extremely insoluble in water or other solvents. DNC is complexed with HDP to facilitate biological absorption. DNC remains in the bird for up to four days and is excreted through the liver in the feces whereas HDP is excreted rapidly through the kidneys in the urine. DNC alone is very poorly absorbed and requires the HDP component for absorption and to achieve a contraceptive blood level.

The representative parameter of nicarbazin bait absorption is the level of DNC in the blood plasma. Once absorbed, nicarbazin has the identical contraceptive action – depositing in the egg and interfering with hatchability – in all birds.

**Absorption of Nicarbazin – DNC in the Blood**

Yoder\(^1\) confirmed that different species absorb DNC at dissimilar rates but excrete the compound at similar rates. The chicken is the most efficient absorber of nicarbazin followed by ducks, geese and pigeons. Birds must absorb nicarbazin at an adequate and consistent rate in order to reach an effective contraceptive blood plasma level. In other words, a single or intermittent dose will not affect hatchability. The active ingredient must be consumed daily, consistently and in adequate quantity in order to achieve the contraceptive effect.

The dose rates in Table 1 illustrate the differences in mg/kg body weight/day, a common denominator,

<table>
<thead>
<tr>
<th>Species</th>
<th>mg/kg bw/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken</td>
<td>11.5</td>
</tr>
<tr>
<td>Duck</td>
<td>24.2</td>
</tr>
<tr>
<td>Goose</td>
<td>35.5</td>
</tr>
<tr>
<td>Pigeon</td>
<td>83.3</td>
</tr>
</tbody>
</table>

According to the Avery\textsuperscript{2} studies, smaller birds have the most inefficient absorption of nicarbazin, requiring a higher bait concentration and dose. Smaller birds, including passerines, with shorter gut transit time, require an even higher dose. A pigeon requires a dose rate of 83mg/kg bw/day. Assuming similar values for pigeons and passerines, a 150g passerine would require 2.5g of OvoControl G 0.5% to obtain the recommended dose. The effect, however, would only occur with daily and consistent exposure during their respective breeding season. Supervision by licensed pest control operators and periodic observations of the application sites helps ensure that non-target exposure is extremely unlikely.

\textbf{Acute Toxicity of Nicarbazin in Birds}

The non-toxic nature of nicarbazin has been studied and is well documented in the literature\textsuperscript{3}. Following more than 50 years of research, the only consistent effect is the reduction of egg hatchability and production in birds following ingestion of nicarbazin. The phenomenon is a function of dose and time. The literature also reveals that nicarbazin does not bio-accumulate and that reproduction returns to normal again within 7-10 days once withdrawn\textsuperscript{4}.

According to the EPA classification system, nicarbazin is considered “practically non-toxic”\textsuperscript{5}. The acute toxicology values for nicarbazin in sensitive birds are provided in Table 2.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
Species & Toxicity Value \\
\hline
Mallard duck & LC\textsubscript{75} = 3680 ppm in total diet \\
Northern Bobwhite & LC\textsubscript{50} > 5720 ppm in total diet  \\
& LD\textsubscript{50} > 2250 mg/kg bw \\
\hline
\end{tabular}
\caption{Acute Toxicity Values of Sensitive Bird Species to Nicarbazin\textsuperscript{6}}
\end{table}

Nicarbazin is not only considered practically non-toxic in birds but also in mammals and other species. For example, the LD\textsubscript{50} in mice and rats is greater than 10,000mg/kg. Put in perspective, nicarbazin has similar acute toxicity values as table sugar.

\textbf{Summary}

DNC, the active component of nicarbazin, circulates in the blood and interferes with hatchability when deposited in the egg. Nicarbazin must be dosed and absorbed in adequate quantity to achieve a contraceptive blood level. DNC alone is poorly absorbed and must be complexed with HDP to be biologically available and effective.

The only consistent effect for nicarbazin is the interference with egg hatchability and production in birds. According to EPA, nicarbazin is classified as “practically non-toxic”, the least toxic classification.


\textsuperscript{5} EPA Fact Sheet. Nicarbazin Conditional Registration, Nov 2005.


\textsuperscript{7} LC\textsubscript{50} (lethal concentration) – 50% of the birds die within 5 days.

\textsuperscript{8} LD\textsubscript{50} (lethal dose) – 50% of the birds die with a single dose.