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# Natamycin In Ripening Cheeses

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**Abstract:** "Delvocid" (Gist Brocades nv.) a preparation containing the natamycin, a substance used in the therapeutics, is used in cheese making to protect a cheese surface against mould development. This preparation is added either to polyvinyl acetate (PVA) used for cheese coating or as an aqueous suspension in which cheese is immersed before the ripening. The natamycin content in the outer layer of cheese was determinated by a spectrophotometric method. During maturation of cheese coated with natamycin-containing polyvinyl acetate, the natamycin did not migrate into the cheese. The natamycine concentration in cheeses that had been immersed in an aqueous solution of natamycin was considerably higher than that in PVA-coated cheeses and was related to the type of cheese, concentration of the "Delvocid" preparation, the length of time for which the cheese was held in solution.

**Key Words:** Cheese, natamycin, migration into the cheese, mould development

## Introduction

Environmental conditions prevailing during cheese ripening, combined with the composition of the cheese often create possibilities for extensive development of mould on cheeses surfaces, which reduces considerably its quality. As a result of mould growth, aflatoxins may be produced in cheese, rendering it unfit for human consumption (Kiermeier and Zeier, 1975; F.I.L., 1977). Therefore, during ripening, cheeses are protected against development of mould by coating of their surfaces a protective layer.

The use of "Delvocid" (Gist Brocades NV), containing 50% natamycin has considerably facilitated protection of cheeses against mould growth during ripening. "Delvocid" may either be added to brine, used as an aqueous suspension for dipping of cheeses or added to polyvinyl acetate used to coat the cheese.

Natamycin, at a concentration considerably lower than other known fungicides, destroys both mould hyphae and spores (Moll, 1966; Shahani *et al*., 1985). Until now, cheeses have been protected against mould growth by treatment with propionic acid (Kujawski *et al*., 1983), sodium, calcium or potassium sorbate (Moll, 1966; Lück, 1972; 1975).

The inhibitory concentration of sorbate is as high as 300 mg/dm$^2$ of cheese surface while the permissible concentration of natamycin is only 2 mg/dm$^2$ (WHO, 1976). Sorbate diffuses into cheese and affects its organoleptic properties (De Ruig and Von Der Berg, 1985) whereas the migration of natamycin is negligent, and when used in polyvinyl acetate, it remains on a surface of the cheese (Kiermeier and Zeier, 1975; Reps *et al*., 1987).

Because natamycin is used as a human medicine, it is necessary to determine its concentration in various types of cheese and the rate of its decay.

In the present study, the suitability of "Delvocid" for inhibition of mould on cheese surfaces was investigated. The experiments were made on Salami (Tilsit type cheese) and Jeziorański (Münster type cheese) cheeses ripened on dry surface for four weeks.

## Material and Methods

To determine the suitability of "Delvocid" as a fungicide for cheese, cheeses were subjected to one of the following treatments:

* Cheeses Salami and Jeziorański were dipped into 0.2 and 0.4% aqueous suspension of the preparation for 60 sec, before brining.
* Salami and Jeziorański cheeses were salted in brine containing 0.2% "Delvocid".
* Salami and Jeziorański cheeses were immersed for 30 and 60 sec in a 0.2 and 0.4% aqueous suspension of "Delvocid" after brining.
* In order to examine an influence of cheese rind on the natamycin content in the outer layers of the cheeses, standard Salami cheese and Salami with the rind removed, were immersed for 60 sec in a 0.4% aqueous suspension of "Delvocid".
* Gouda type cheeses were immersed for 30 sec in a 0.2% aqueous suspension of "Delvocid" and packed in Cryovac bags while wet or after drying the surface. Cheese was also packed in bags which had been dipped in a 0.2% aqueous suspension of "Delvocid".
* Edam cheeses, after brining, were coated with one, two and three layers of polyvinyl acetate containing 0.1% of "Delvocid". After one week of ripening, half of the cheeses from each lot were covered with cheese wax.

During the ripening of cheeses, the effectiveness of antifungal action of natamycin was observed (compared

Table 1: Natamycin concentration in 1 mm thick surface layer of cheeses, immersed in an aqueous suspension of "Delvocid" before brining

| Concentration of "Delvocid" % | Duration of ripening (days) | Salami cheese | Jezioranski cheese |
|---|---|---|---|
| | | Natamycin concentration (mg/dm$^2$) | |
| 0.2 | 4 | 0.18 | 0.22 |
| | 9 | 0.16 | 0.15 |
| | 14 | 0.10 | 0.00 |
| | 19 | 0.00 | 0.00 |
| | 24 | 0.00 | 0.00 |
| | 28 | 0.00 | 0.00 |
| 0.4 | 4 | 0.36 | 0.37 |
| | 9 | 0.31 | 0.31 |
| | 14 | 0.18 | 0.31 |
| | 19 | 0.11 | 0.14 |
| | 24 | 0.05 | 0.00 |
| | 28 | 0.00 | 0.00 |

Table 2: Influence of rind on the natamycin concentration in the surface layer of Salami cheeses immersed for 60 Sec in an aqueous suspension of "Delvocid"

| State of cheese surface | Duration of ripening (days) | Layer of cheese | | | | |
|---|---|---|---|---|---|---|
| | | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 |
| | | Natamycin concentration (mg/dm$^2$) | | | | |
| Control cheese | 4 | 1.66 | 0.14 | 0.0 | 0.0 | 0.0 |
| | 14 | 1.39 | 0.27 | 0.0 | 0.0 | 0.0 |
| Cheese after rind removal | 4 | 4.11 | 1.85 | 1.11 | 0.48 | 0.0 |
| | 14 | 3.23 | 2.01 | 1.82 | 0.94 | 0.45 |

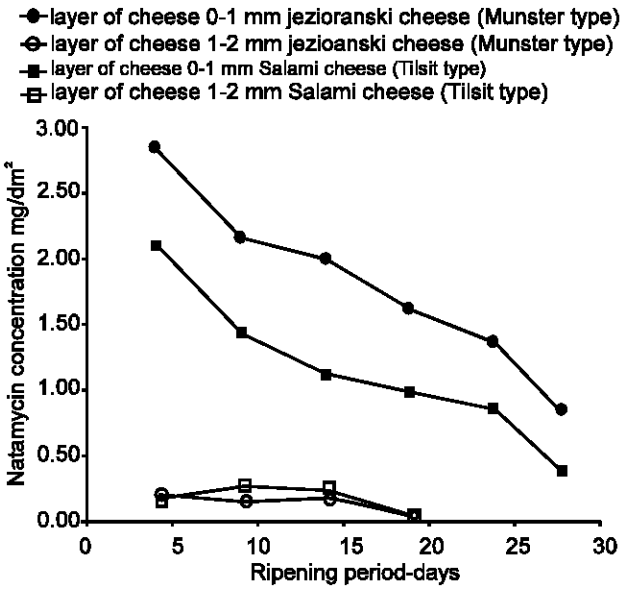


Fig. 1: Natamycin concentration in the surface layer of cheese after salting in brine containing 0.2 % "Delvocid"

to the control cheeses) and its concentration in five consecutive, 1 mm-thick layers of cheese was determined, by the spectrophotometric method (De Ruig and Von Der Berg, 1985).

## Results and Discussion

In cheeses, that had been immersed in and aqueous suspension of "Delvocid" before brining the concentration of natamycin on the surface of cheeses was insignificant (Table 1), presumably due to washing out the natamycin (which is insoluble in water) from the surface of cheeses by the brine. In spite of the low concentration of natamycin, little mould development was observed after two weeks of ripening whereas mould development was observed considerably earlier on control cheeses.

It should be mentioned that under the industrial conditions, the concentration of natamycin capable of inhibiting mould development on the surface of cheese may depend on the type of cheese and environmental conditions in the ripening room.

The concentration of natamycin in the outermost 1 mm-thick outer layer of Jeziorański and Salami cheeses after salting in natamycin-containing brine was 2.84 and 2.09

Table 3: Natamycin concentration in surface layers of Gouda cheese, ripening in Cryovac plastic bags

| Procedure | Duration of ripening (days) | Layer (mm) | Natamycin concentration (mg/dm$^2$) |
|---|---|---|---|
| Cheese packed in film in a wet state | 21 | 0-1 | 0.90 |
| | | 0-2 | 0.00 |
| | 26 | 0-1 | 0.64 |
| | | 1-2 | 0.00 |
| | 32 | 0-1 | 0.31 |
| | | 1-2 | 0.00 |
| | 38 | 0-1 | 0.11 |
| | | 1-2 | 0.00 |
| | 42 | 0-1 | 0.00 |
| | | 1-2 | 0.00 |
| Cheese packed in film after drying of its surface | 21 | 0-1 | 0.32 |
| | | 1-2 | 0.00 |
| | 26 | 0-1 | 0.12 |
| | | 1-2 | 0.00 |
| | 32 | 0-1 | 0.11 |
| | | 1-2 | 0.00 |
| | 38 | 0-1 | 0.00 |
| | | 1-2 | 0.00 |
| | 42 | 0-1 | 0.00 |
| | | 1-2 | 0.00 |
| Cheese packed in film soaked in an 0.2 % aqueous suspension of "Delvocid" | 21 | 0-1 | 0.15 |
| | | 1-2 | 0.00 |
| | 26 | 0-1 | 0.08 |
| | | 1-2 | 0.00 |
| | 32 | 0-1 | 0.00 |
| | | 1-2 | 0.00 |
| | 38 | 0-1 | 0.00 |
| | | 1-2 | 0.00 |
| | 42 | 0-1 | 0.00 |
| | | 1-2 | 0.00 |

Table 4: Changes in natamycin concentration in surface layer of Edam cheese

| Duration of ripening in PVA film (days) | Cheese coated with one layer of PVA | | Cheese coated with two layers of plastic | | Cheese coated with three layers of plastic | |
|---|---|---|---|---|---|---|
| | PVA | PVA+wax | PVA | PVA+wax | PVA | PVA+wax |
| | Natamycin concentration (mg/dm$^2$) | | | | | |
| 4 | 0.43 | 0.43 | 0.68 | 0.68 | 0.98 | 0.98 |
| 8 | 0.27 | 0.27 | 0.38 | 0.28 | 0.63 | 0.63 |
| 11 | 0.18 | 0.23 | 0.26 | 0.37 | 0.54 | 0.48 |
| 15 | 0.14 | 0.20 | 0.17 | 0.28 | 0.38 | 0.41 |
| 18 | 0.00 | 0.16 | 0.00 | 0.21 | 0.25 | 0.26 |
| 21 | | 0.00 | | 0.16 | 0.14 | 0.17 |
| 23 | | | | 0.00 | 0.00 | 0.11 |
| 25 | | | | | | 0.00 |

mg/dm² respectively (Fig. 1), which exceeded the permissible concentration. During ripening, a rapid decline in the concentration of natamycin in cheese was observed. On the 28th day of ripening, before the cheeses were distributed, the concentration of natamycin in Salami cheese was 0.32 mg/dm², and in Jeziorański cheese was 0.79 mg/dm². Traces of natamycin were also found in the second 1 mm layer of cheeses from the surface (1-2 mm) (Fig. 1). Throughout ripening, moulds did not grow on the surface of the experimental cheeses.

In Jeziorański cheese, that was immersed in an

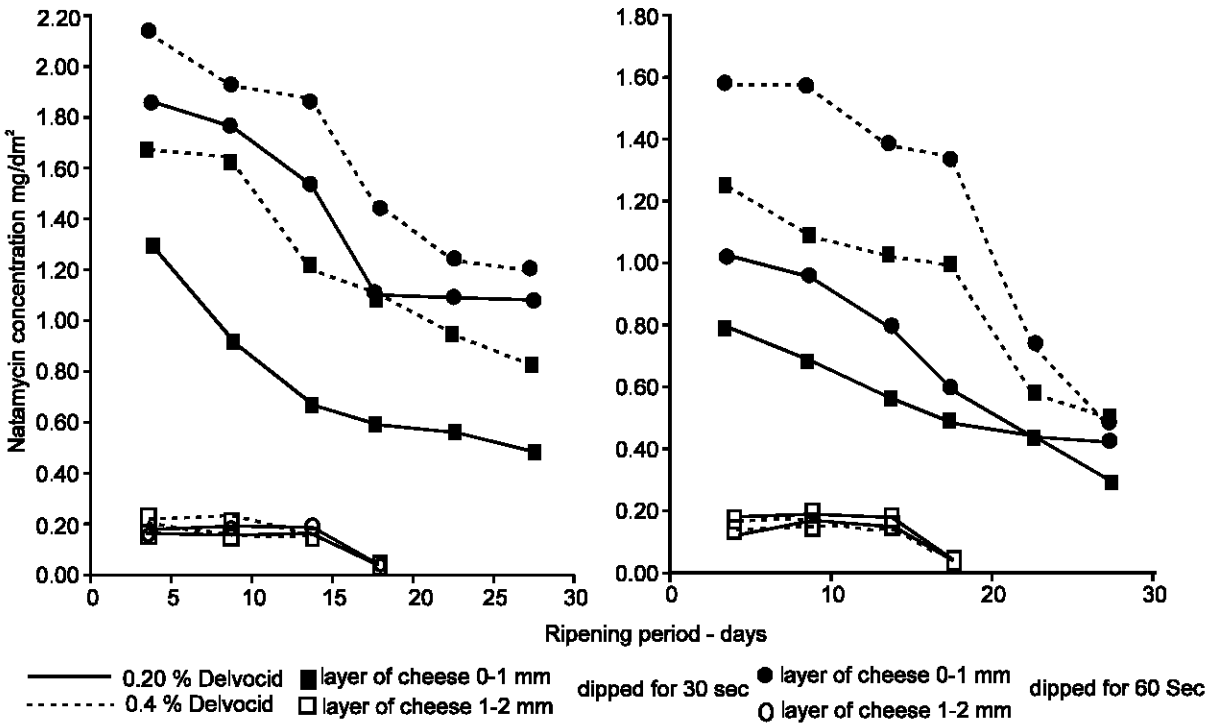


Fig. 2: Natamycin content in surface layer of cheeses, after salting, dipped in aqueous suspension of the "Delvocid"

aqueous suspension of "Delvocid" after brining, the natamycin content was higher than that in Salami cheeses that had been treated similarly (Fig. 2). However, only in case of cheese that had been immersed for 60 sec in a 0.4% suspension of "Delvocid", did the natamycin level exceeded the permissible concentration during the initial period of ripening. During ripening, inactivation of natamycin was observed and was more intensive in Salami cheese. In the second layer from the outside of the cheese, the natamycin content was insignificant and by the 18th day of ripening had decreased to non-detectable levels. The higher concentration of natamycin on the surface of Jeziorański cheese can be explained by the fact that its rind is more porous (non-pressed cheese) than that in Salami cheese (pressed cheese).

During the ripening of Jeziorański and Salami cheeses, the development of mould on their surface was not observed. Other authors (Gripon and Bergere, 1972; Engel *et al.*, 1983) also showed that the concentration of natamycin in the outer layer of cheese and the depth of its migration depended on the type of cheese and on the duration of immersion in the suspension of "Delvocid".

A major influence of the rind on the concentration of natamycin in cheeses, as well as on the depths of its migration, was confirmed (Table 2). On the 4th day of ripening in the cheeses from which the rind had been removed, the concentration of natamycin in the outermost layer of cheeses was by 2.5 times higher than that in cheeses with the rind. In rindless cheeses, the migration of natamycin to a depth of 5 mm was observed.

The result of the study showed that natamycin protects the surface of cheese against the development of mould. For the efficient protection of the surface of Salami and Jeziorański cheeses it is recommended to salt them in brine containing 0.2% "Delvocid" or to immerse them for 30 sec in a 0.4% aqueous suspension of "Delvocid". The suspension of "Delvocid" in water or brine may be used for a long period.

The concentration of natamycin in the outer layers of cheese depends on the type of cheese, rind performance and the method of application of "Delvocid". During ripening, natamycin adsorbed in the outer layer of the cheeses is inactivated quickly. After four weeks of ripening, before the distribution of cheeses to retailers, natamycin was present only, in the negligent quantities, in 1-mm thick outer layer of the cheeses.

Immersing Gouda cheese for 30 sec in a 0.2% aqueous suspension of "Delvocid" before packing in Cryovac film, or soaking only of the bags in the above mentioned suspension effectively protected the surface of the cheese from the development of mould, even when the coating was damaged.

Natamycin present in "Delvocid" did not migrate into the Gouda cheese (Table 3). After the ripening period, requested by Polish quality standards, natamycin was not found in cheeses.

In order to protect the surface of cheeses from the mould growth, polyvinyl acetate (PVA) containing 0.05 % natamycin is usually applied. In Edam cheeses, coated with one, two, or three layers of PVA, the concentration of natamycin in the 1-mm outer layer of cheese was 0.43, 0.68 and 0.98 mg/dm$^2$ of cheese, respectively (Table 4). Natamycin was not present in the second layer of cheese.

In the cheeses coated with one or two layers of PVA, natamycin was present for 15-18 days of ripening and when three layers of PVA were applied, it was present for 21-23 days. Early additional coating of cheeses with wax prolongated by a few days the presence of natamycin in cheese.

After from five to six weeks of ripening period cheeses did not contain natamycin.

Polyvinyl acetate containing of 0.05% natamycin effectively protected the surface of cheeses against the development of undesirable moulds and simplified handling of cheese during the ripening period.

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