# The Effect of Sodium Alginate, Hydroxy Propyl Methyl Cellulose E15 and Ethyl Cellulose N22 as Polymeric Matrices on the Physicochemical Characteristics of Meloxicam Patch

*by* Tristiana Erawati

# The Effect of Sodium Alginate, Hydroxy Propyl Methyl Cellulose E15 and Ethyl Cellulose N22 as Polymeric Matrices on the Physicochemical Characteristics of Meloxicam Patch

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ABSTRACT: Meloxicam is an NSAID that can cause gastric irritation when orally administered. Transdermal drug delivery system can avoid its side effects and avoid first-pass metabolism in the liver. In this study, matrix type transdermal patches containing meloxicam were prepared using different ratios of sodium alginate, hydroxypropyl methylcellulose (HPMC) E15, and ethyl cellulose (3:2:0.5 ; 2.5:2:1 ; 2:2:1.5 and 1.5:2:2). The transdermal patches of meloxicam were prepared by mixing all dispersion polymers matrix and meloxicam. The patches were evaluated for physicochemical assessment (organoleptic, moisture content, surface morphology, drug content, and homogeneity). The result showed that there were differences in both moisture content and mass variation. The percent of moisture content and mass variation were increased as the amount of hydrophilic polymer increases. Formula 1.5:2:2 showed the best characteristic because it had low moisture content, however, it still needs further studies, such as stability, drug release, and penetration studies.

Keywords: transdermal patches, meloxicam, sodium alginate, HPMC E15, EC N22, physicochemical studies

## 1. INTRODUCTION

Meloxicam is an non-steroid anti-inflammatory drug (NSAID) that has a mechanism of inhibiting cyclooxygenase, this inhibition can cause reduced protection of the gastric mucosa (O'Neil et al. 2006). Meloxicam formulations are effective for the treatment of osteoarthritis with a dose of 7.5 mg per day. To reduce the side effects of drugs against digestion, they can be made into transdermal preparations (Allen and Ansel, 2014). The principle of patch preparations can be divided into two groups, namely membrane systems and matrix systems. In patch matrix type, drug release depends on polymer matrix composition. The effectiveness of patches is determined by good characteristics. The combination of hydrophilic and hydrophobic polymers is important in the effectiveness of patches. In this study patches will be developed with a combination of sodium alginate polymer, HPMC E15, and EC (3: 2: 0.5; 2.5: 2: 1; 2: 2: 1.5 and 1.5: 2: 2).

The purpose of this study was to determine the effect of polymer combinations on the characteristics of patches.

## 2. MATERIALS AND METHODS

### 2.1 Materials

Materials used were meloxicam (Sun Pharmaceutical), hydroxypropyl methylcellulose E15 (HPMC E15) (Wuhan Chemical), alginate sodium (Tristar Chemical), ethylcellulose N22 (EC N22) (Dow Chemical), methyl acrylate, menthol, chloroform, propylene glycol, and ethanol derived from PT Bratachem. Materials used have a high pharmaceutical purity grade.

## 2.2 Methods

### 2.2.1 Preparation of Meloxicam Patch matrix type

The matrix patch consists of a mixture of all active ingredients as shown in Table 1. The polymers used are HPMC E15, EC N22 and Sodium alginate. The process of making the meloxicam patch is described below: HPMC is dissolved in 5 ml of ethanol and the EC is dissolved in 2 ml of ethanol. Sodium alginate is dispersed into propylene glycol, then added with already dissolved HPMC and EC and then stirred until homogeneous. This solution is then referred to as a base patch. Furthermore, meloxicam is dissolved in chloroform and mixed into the base patch. Menthol and methyl acrylate are then added to the patch mixture then stirred until homogeneous. After mixing, the solvent is evaporated first and then the mixture is poured into a mold and dried in an oven at 40°C for 1 hour 46 minutes.

Table 1. Formula of Meloxicam Patch matrix type

| Compound | Concentration (% w/w) | | | |
| --- | --- | --- | --- | --- |
| | Formula 1 AHE=3:2:0.5 | Formula 2 AHE=2.5:2:1 | Formula 3 AHE=2:2:1.5 | Formula 4 AHE = 1.5:2:2 |
| Meloxicam | 1.5 | 1.5 | 1.5 | 1.5 |
| Na Alginat | 36.8 | 30.7 | 24.5 | 18.5 |
| HPMC E15 | 24.5 | 24.5 | 24.5 | 24.5 |
| EC N22 | 6.2 | 12.3 | 18.5 | 24.5 |
| Methyl acrylate | 30 | 30 | 30 | 30 |
| Menthol | 1 | 1 | 1 | 1 |

Note : AHE= Na Alginat:HPMC E 15: EC N22; Total compound of 1 patch= 500 mg
Every patch contain 7.5 mg Meloxicam per 500 mg patch mass

### 2.2.2 Evaluation of meloxicam patch matrix type

The evaluation of the Meloxicam patch preparation was carried out by observing organoleptic, moisture content, surface homogeneity and determination of drug content.

### 2.2.3 Organoleptic

Organoleptic examination is done by observing the color, smell and consistency of patches visually.

### 2.2.4 Moisture content (MC)

The patch is weighed separately before being stored in a desiccator containing calcium chloride at room temperature for 24 hours. After 24 hours, the patch will be weighed again to determine the percentage of water content. Percentage of moisture content is calculated as follows (Hendradi et al. 2011):

$$\text{Percentage of moisture content} = [\text{Initial weight - final weight / initial weight}] \times 100\%$$

### 2.2.5 Homogeneity of the surface

Homogeneity of the surface of patch was observed using Scanning Electron Microscopy (SEM) (Hendradi et al. 2011).

### 2.2.6 Determination of drug content

This test was conducted to determine the variation of drug content in patch preparations. This test was carried out by dissolving the preparation in 100 mL of ethanol mixture - buffer pH 7.4 with a ratio of 3:7 (v/v). Then the solution was centrifuged at 3000 rpm for 10 minutes. Then the solution was analyzed using UV-VIS spectrophotometry method.

### 2.2.7 Statistical analysis

The statistical analysis was performed using independent t-test with SPSS and 0.05 degree of confidence.

### 2.2.8 Homogeneity of drug content

Patch was divided into 4 parts. Each part was taken into a 25ml volumetric flask containing 25 ml phosphate buffer: ethanol (7:3) and stirred for 1 hour and the sample was centrifuged and analysed by UV spectrophotometer at 360nm.

## 3. RESULT AND DISCUSSION

### 3.1 Organoleptic

Organoleptic observation of meloxicam patch preparation was carried out visually. The result showed that combination polymers have no effect on the organoleptic properties of the patches. Result is shown in Table 2.

Table 2. Organoleptic examination data for meloxicam patches.

|  | Formula (3:2:0.5) | Formula (2.5:2:1) | Formula (2:2:1.5) | Formula (1.5:2:2) |
|---|---|---|---|---|
| Consistency | Bending, not easily broken | Bending, not easily broken | Bending, not easily broken | Bending, not easily broken |
| Colour | Yellow | Yellow | Yellow | Yellow |
| Odor | Odorless | Odorless | Odorless | Odorless |

### 3.2 Moisture content

Moisture content data of meloxicam patch preparation from each formula can be seen in the Table 3. Based on the ANOVA one way statistical test on the determination of the MC test, it is seen that the sig value is <0.05, so statement H0 is rejected. It means that there is meaningful differences between %MC of each formula.

Table 3. Moisture content data of meloxicam patch preparation.

| Formula | % Moisture content | | | Average ± SD | % Coeff. Var |
|---|---|---|---|---|---|
|  | Rep. 1 | Rep. 2 | Rep. 3 |  |  |
| Formula (3:2:0.5) | 7.28 | 7.20 | 7.21 | 7.23 ± 0.043 | 0.60 |
| Formula (2.5:2:1) | 6.54 | 6.45 | 6.48 | 6.49 ± 0.050 | 0.71 |
| Formula (2:2:1.5) | 6.74 | 6.65 | 6.63 | 6.67 ± 0.059 | 0.88 |
| Formula (1.5:2:2) | 5.80 | 5.86 | 5.76 | 5.81 ± 0.050 | 0.87 |

### 3.3 Homogeneity of the surface

The observation on meloxicam matrix type transdermal patch using scanning electron microscopy with 5000x magnification. The result can be seen in Figure 1.
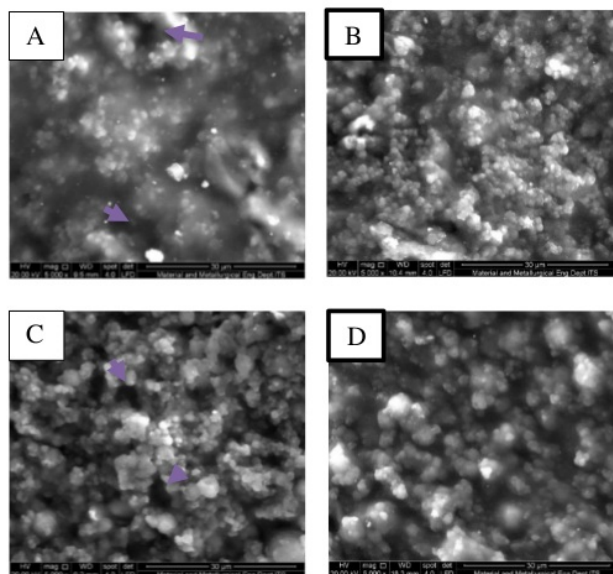


Figure 1. Result scanning electron microscopy A: formula (3:2:0.5), B: formula (2.5:2:1), C: formula (2:2:1.5), D: formula (1.5:2:2).

*3.4 Determination of drug content*

Drug content data of meloxicam patch preparation from each formula can be seen in the Table 3. Based on the ANOVA one way statistical test on the determination of the MC test, it is seen that the sig value is >0.05, so statement H0 is accepted. It means, there is no meaningful difference of each formula.

Table 4. Drug content data of meloxicam patch.

| Formula | % Drug content | | | Average ± SD | % CV |
|---|---|---|---|---|---|
| | Rep.1 | Rep.2 | Rep.3 | | |
| Formula (3:2:0.5) | 97.0% | 100.0% | 98.2% | 98.4% ± 1.50 | 1.52 |
| Formula (2.5:2:1) | 99.1% | 96.7% | 96.4% | 97.4% ± 1.49 | 1.52 |
| Formula (2:2:1.5) | 95.2% | 97.6% | 97.6% | 96.8% ± 1.39 | 1.43 |
| Formula (1.5:2:2) | 92.2% | 93.4% | 92.5% | 92.7% ± 0.63 | 0.68 |

*3.5 Homogeneity of drug content*

The total quarter drug content data of a meloxicam patch, prepared from each formula is shown in Table 4. The results showed that all formulas met the range of requirements for content homogeneity (85-115%) with% KV < 2%.

Table 5. Percent of meloxicam drug content from a quarter part of patch.

| Formula | % Drug content | | | Average ± SD | % CV |
|---|---|---|---|---|---|
| | Rep.1 | Rep.2 | Rep.3 | | |
| Formula (3:2:0.5) | 94.6% | 95.0% | 95.7% | 95.1% ± 0.15 | 0.63 |
| Formula (2.5:2:1) | 97.7% | 99.2% | 98.6% | 98.5% ± 0.75 | 0.75 |
| Formula (2:2:1.5) | 93.6% | 93.1% | 94.3% | 93.7% ± 0.16 | 0.67 |
| Formula (1.5:2:2) | 90.7% | 91.9% | 92.4% | 91.6% ± 0.87 | 0.94 |

## 4. CONCLUSION

Polymer combinations affected the characteristics of moisture content (patches). From the result, %MC Formula of natrium alginate is in the ratio of HPMC E15: EC (3:2:0.5) > (2:2:1.5) > (2.5:2:1) > (1.5:2:2). Formula (1.5:2:2) has better physical characteristics compared to the other formula due to its lower moisture content, therefore, the possibility of bacterial contamination is minimal.

## ACKNOWLEDGEMENT

None

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